FARMERS' EVALUATION AND ADOPTION OF IMPROVED ONION PRODUCTION PACKAGE IN FOGERA DISTRICT, SOUTH GONDAR, ETHIOPIA

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APPROVAL SHEET OF THESIS

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As Thesis Research advisor, I here by certify that we have read and evaluated this thesis prepared, under our guidance, by Tadesse Adgo Mihiretu, entitled **Farmers Evaluation and Adoption of Improved Onion Production Package in Fogera District, South Gondar, Ethiopia.** I recommend that it can be submitted as fulfilment of the Thesis requirement.

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DEDICATION

I dedicate this thesis manuscript to poor farmers of *Fogera* district who gave me unrestricted information for this research.

STATEMENT OF AUTHOR

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BIOGRAPHY

The author, Tadesse Adgo Mihiretu was born in *Banja Shikudad* District of the Amhara National Regional State on September 6, 1966. He attended his elementary and junior school education in the same district and later attended his High-school education at *Finote Selam* Senior secondary school. After completion of his high school education, he joined Ambo Junior Agricultural College and completed two years Diploma program in General Agriculture.

After graduation he was employed in Ministry of Agriculture and served the organization for more than 13 years. He got an opportunity to join at Alemaya University for his degree program in Agricultural Extension as Mid-career student from 1999 to 2002.

After completion of the under graduate degree, he served the Amhara Regional Bureau of Agriculture for five years and returned back to Haramaya University to attend his post graduate study in 2007.

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ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
CIMMYT	International Maize and Wheat Improvement Centre
CSA	Central Statistical Authority
EARO	Ethiopian Agricultural Research organization
FAO	Food and Agriculture Organization of united nations
ha	Hectare
HH	Household Head
HYV	High Yielding Varieties
ILRI	International Livestock Research Institute
IPMS	Improving Productivity and Market Success Ethiopian Farmers Project
Kg	Kilogram
MoARD	Ministry of Agriculture and Rural Development
NGOs	Non Governmental Organizations
SD	Standard Deviation
ANRS	Amhara National Regional State
SPSS	Statistical Package for Social Science
TLU	Total Livestock Unit
VIF	Variance Inflation Factor

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FARMERS EVALUATION CRITERIA AND ADOPTION OF IMPROVED ONION PRODUCTION PACKAGE

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ABSTRACT

Onion is one of the most important horticultural crops categorized under root crops. A global review of major vegetables shows that onion ranks second under area cultivation. Ethiopia has an enormous potential for production of vegetable crops in general and onion particular and it is also among the most important export crops. Onion is one of the most important vegetable crops grown in the study area, Fogera. It contributes to the major share of daily cash source. The objectives of this study were: to identify farmers' evaluation and selection criteria of improved onion varieties disseminated in the study area; to identify intensity of adoption of farmers in the study area. This study interviewe140 sample households using structured questionnaire and out of the total 140 sample households 10% were women. In this study, data were collected and analyzed qualitatively and quantitatively. Quantitative data analysis methods were employed mainly with chi-square, F-test and Tobit model using SPSS and Limdep computer soft ware. In farmers' evaluation and selection criteria of improved onion varieties disseminated in the study area Bombay red ranks first and Adama red ranks second. Early maturity, good yield, large bulb size, and good bulb colour were the most important traits of improved onion identified as a selection and evaluation criteria in the study area. Result of the econometric model indicated that household head's education status of the household head access credit, participation in extension event (participation in training and field day), participation cooperative society and frequency of visiting out side his/her social system were important variables which had positively and significantly influenced adoption and intensity of adoption of improved onion production package. Where as, farmers' perception towards improved onion production technology had shown negative relationship with adoption and intensity of adoption. All most all farmers who adopted improved onion varieties have not implemented the recommended spacing mainly due to its labour intensive practice. The overall finding of the study underlined the high importance of institutional support in the areas of extension training; strengthening cooperative societies, and improving market condition to enhance adoption of improved onion production package.

1. INTRODUCTION

1.1 Background of the Study

More than 85% of the Ethiopian population, residing in the rural area, is engaged in agricultural production as a major means of livelihood. However, the agricultural productivity is low due to use of low level of improved agricultural technologies, risks associated with weather conditions, diseases and pests, etc. Moreover, due to the ever increasing population pressure, the land holding per household is declining leading to low level of production to meet the consumption requirement of the households (Bezabih and Hadera , 2007).

A close look at the performance of the Ethiopian agriculture reveals that over the last three decades it has been unable to produce sufficient quantities to feed the country's rapidly growing human population (Belay and Degnet, 2004). To ensure food security, the country needs to improve its agricultural sector in sustainable manner. The Ethiopian rural development policy and strategy document has given weight to follow diversification and specializations in production systems, as one of the strategies to ensure households food security.

In most irrigable lands, horticultural crops in general and vegetables in particular, play an important role in contributing to the household food security. The vegetable being cash crop with nutritional value generate income for the poor households. Higher profits can be achieved by increasing the production of a particular vegetable through out the year when efficient irrigation system is used.

Horticultural production is usually money spinning as compared to staple crops. The production of fruits and vegetables has a comparative advantage particularly under conditions where arable land is scarce, labor is abundant and markets are accessible (Lumpkin et al., 2005).

The production of horticultural products offers opportunities for poverty alleviation, because it is usually more labour intensive than the production of staple food crops. Hence, the generation of additional employment opportunities in rural areas where labour is abundant is made possible.

Cultivation of fruits and vegetables allows for productive employment where the labour land ratio is high, since horticultural production is usually labour intensive. Depending on the crop, production of horticulture crops requires at least twice the labour, and up to five time the labour days per ha as compared to cereal crops. Increasing horticultural production contributes to commercialisation of the rural economy and creates many off-farm jobs (Lumpkin *et al*., 2005).

Ethiopia has enormous potential to cultivate vegetables on small scale as well as commercial scale. Onion crops are the most important cultivated crops in the country. The CSA report of the production year 2005/06 for the private holding indicated the status of root (*beetroot, onion, potato, garlic*) crops production. According to the report, the volume of root crops produced and the area under root crops production during the year 2005/06 in the country are about 4.5 million quintals and 169343 hectares respectively. Out of this volume, onion takes the share of 1759192 quintals and 16578 hectares.

Due to such an important contribution of onion to the country, some efforts have been made by both research and extension systems for its promotion. Different research centres under Ethiopian Agricultural Research Organization have released improved onion varieties. And the technology is disseminated among farmers with full package of information as a new innovation through MoARD.

The extension interventions by MoARD and NGOs assist farmers in adoption of the innovation of onion production in most part of the country. Because of these intervention efforts, currently farmers living in most irrigable areas of the Amhara region produce large amount of onion bulbs every year. For instance, in 2005/06 production year the region contributes 706526 quintals onion bulb with 5338 hectares of land coverage of onion crop

With this respect all introduced technology packages of onion verities are not fully adopted by onion growers. This may be due to personal, social, economical, institutional or technological

factors. To promote higher adoption and understand of the reasons, why farmers adopt or reject the recommended technology is an important concern for the people dealing with agricultural development. Unfortunately, the studies focused on farmers' preference & evaluation criteria and factors determining the intensity of adoption of onion production package are scanty. This study was conducted in South Gondar especially Fogera district where such studies had not conducted previously.

Therefore, this study was aimed at identifying farmers' criteria to choose improved varieties and assessing factors influencing the intensity of adoption of improved onion production package.

1.2 Statement of the Problem

Vegetable crops play an important role in contributing to the household food security. In addition to the nutritional value, these crops generate employment opportunities for the poor households. In most irrigated fields, farmers achieved better income by improving the production of vegetable crops. Onion is one of the important vegetable crops grown by farmers mainly for market purpose. In Ethiopia currently onion covers about 17,980 ha with estimated annual production of 2.3 million quintals (MoARD, 2005).

Research efforts have been made to generate and release improved varieties of vegetable crops during last two decades. During this period a number of improved varieties of onion has been developed and disseminated among the farmers through different extension organizations such as MoARD and NGOs.

Fogera district, the study area, has tremendous potential for onion cultivation. Due to availability of ample irrigated farmland and the presence of relatively better market access as compared to other area, many of the farmers in the area have adopted improved onion technology packages. Currently the farmers living in the study area are growing the verities Adama red and Bombey Red varieties in their fields. There are tremendous factors which influence the adoption of improved onion production package. Further the farmers are not adopting the complete package of practices recommended by the research system. We assume that there are some factors

influencing the farmers' decision to adopt the onion production package. The intensity of adoption of improved onion production package varying from situation to situation and person to person.

Shading light on to those factors which make a difference in the adoption level of improved onion production package among the farmers was the main theme of this study. The findings of this study assumed to be very valuable information for further promotion of this important crop in the study area. Further more farmers' technology evaluation criteria would help researchers to develop technologies appropriate to local situation and in line with the farmers' criteria. The technologies developed at research stations under controlled environment and evaluated by the researchers' criteria only, usually do not meet farmers' needs and farmers simply discard such type of technologies. However, farmers' technology evaluation criteria as well as factors influencing the intensity of adoption of improved onion production package differ from person to person and location to location.

Keeping these critical issues in view, the present study is aimed at finding out factors influencing intensity of the adoption of improved onion production package and the evaluation criteria they follow for adoption of improved onion varieties.

1.3 Objectives of the Study

The general objective of the study is, to identify farmers' evaluation criteria and the intensity of adoption of onion production technology in the study area.

1. to identify farmers' criteria for evaluation of improved onion verities in the study area, and
2. to identify major factors influencing the intensity of onion production package adoption in the study area

1.4 Research Questions

1. What criteria do farmers use to evaluate onion variety for its adoption?
2. What are the possible factors influencing the intensity of onion production package adoption in the study area?

1.5 Significance of the Study

Farmers' are not always adopting the newly introduced technologies that come to them from any extension organization as it is. They try to evaluate according to its match with their social, environment and economic importance. So understanding these factors is important for the scientists to develop and generate agricultural technologies, which suits to the current conditions of farmers. Policy makers too will benefit from the research out put since they require micro-level information to formulate and revise policies and strategies.

Thus the study assumed to produce very important information related to farmers' variety evaluation criteria and factors influencing adoption of improved onion production package in the study area. Finally, the information produced from this study is expected to be of some value for technology generators, extension agents and policy makers.

1. 6. The Scope and Limitations of the Study

Among vegetables crops growing in the study area, this study is focused to draw detail information of improved onion production technology package practices by onion growers. Accordingly, technology coverage is limited to only onion production and restricted to *Fogera* district in terms of area coverage. Even though, the results of this study can be used as a reference for other similar studies in other areas.

2. LITERATURE REVIEW

2.1 The Economic Importance of Onion

The primary centre of origin of onion is Central Asia with secondary centre in Middle East and the Mediterranean region. From these centres, onion has spread widely to many countries of the world. Onion is different from the other edible species of alliums for its single bulb and is usually propagated by true botanical seed. According to Dahlgren et al. (1985) onion is one of the oldest cultivated vegetables, and has been in cultivation for more than 4000 years. The earliest records came from Egypt, where it was cultivated at the time of the old kingdom. Carvings of onion can be seen on the walls of pyramids in the 3rd and 4th dynasties.

A global review of major vegetables show that onion ranks second to tomatoes in area under cultivation. According to FAO (1999), over 40 million tonnes of onion were produced worldwide in 1998, covering about 4.5 million hectares. Tropical countries, having about 45% of the world's arable land, grow about 35% of the world's onions (Pathak, 1993). About 8% of the total area was in Africa in 1995. The productivity of tropical onion is around 9.6 tonne/ha, which is very low, compared to the average bulb yield in temperate countries, which is about 19.5 tonne/ha. The world average yield at present is about 17.3 tonne/ha (FAO, 1999).Ethiopia has a great potential to produce onion every year for both local consumption and export with an average yield 13.3 tonne/ha (CSA, 2001/02 as cited Taha 2007).

Onion is grown mainly for its bulbs; although the green shoots of salad onion is also an important crop. The onion bulb consists of the swollen bases (sheaths) of bladed leaves surrounding swollen bladeless leaves. Each leaf consists of a blade and sheath; the blade may or may not be distinctive. The sheath develops to encircle the growing point and forms a tube that encloses younger leaves and the shoot apex. Collectively, the grouping of these sheaths comprises the pseudo-stem. It is used primarily as flavouring agents and its distinctive pungency, which is due to the presence of a volatile oil (allyl propyl disulphide). The mature

bulb contains some starch, appreciable quantities of sugars, some protein, and vitamins A, B, and C (Decoteau, 2000). Onion yield per hectare of sample households was 13060 quintal. This figure is almost similar to than the national productivity reported by CSA (2002) which is 133.92 qt/ha.

Onion was introduced to the agricultural community of Ethiopia in the early 1970s when foreigners brought it in. Though shallots are traditional crop in Ethiopia, onions are becoming more widely grown in recent years. Currently, the crop is produced in different parts of the country for local consumption and for export of flowers to European markets. The average annual sale of dry bulb and cut flowers from Ethiopian Fruit enterprise alone was estimated to be about 6.2 million birr (ETFRUIT, 1992). According to World Bank report (2004), in the year 2001 the crop shared one fourth of the vegetable export quantities and stood third following green beans and peas contributing about 20% of the total vegetable export value which is about 244,000 US dollar of export earning. In addition to dry bulb, onion cut flower also constitutes significant proportion of foreign export values. In between the years 1999-2001 alone, about 1.75 million birr worth cut flower stems were exported. This indicates that Ethiopia has high potential to benefit from onion production. In recent years the demand for onion increased for its high bulb yield, seed and flower production potential. The establishment of state owned enterprises contributed substantially to the increase in the production and expansion of area under onion in the country with limited amount of seed production experiences. Onion seed production depends on the cultivar, location, growing season and adequate plant protection measures (Lemma and Shimelis, 2003:3).

One of the problems of onion production in the tropics is lack of seed which is true to type and of high germination and vigour (Currah and Proctor, 1990). Therefore, it is essential to produce and use fresh seeds for bulb production. Onion seed is usually produced in the temperate and subtropical countries. In the countries where high temperature prevails throughout the year, only the easy-bolting types of onion, requiring relatively low-temperature exposure, can produce seed. Shallots were the traditional vegetative propagated alliaceous crop of the Ethiopian highland, but in the 1980's, Sudanese onion cultivars were selected. To improve onion production, the agricultural research system of the country has made efforts to generate improved varieties.

Currently the research system made available the varieties like; Adama red, Bombey red, Red creole, Melkam, Mermiru brown and Nasik red (Dereselegn) to farmers. Bombay Red and Adama Red are widely grown in Ethiopia. In Ethiopia there is no agency involved in the multiplication and distribution of seed of this cultivar and other cultivars to the farmers. However, seeds of Bombey Red and Adama Red are being produced on limited scale by research centres and some farmers.

Farmers living in the Amhara region produce large amount of onion bulbs every year. For instance, in 2005/06 production year the region contributes 706526 quintals onion bulb with 5338 hectares of land coverage of onion crop. According to the *Fogera* district office of agriculture in 2005/2006 production season the district contributes 355315 quintal with 3100 hectares. This indicates that the district comprises 49.9 % of the regional onion production.

2.2 An Overview of Concept - Adoption

Adoption is a mental process through which an individual passes from first knowledge of an innovation to the decision to adopt or reject and to confirmation of this decision (van den Ban and Hawkins, 1998). According to Feder *et al.* (1985) adoption refers to the decision to use a new technology, method, practice, *etc.* by a firm, farmer or consumer. As indicated by Dasgupta (1989), adoption is not a permanent behaviour. An individual may decide to discontinue the use of an innovation for a variety of personal, institutional or social reasons one of which could be the availability of an idea or practices that is better in satisfying his or her needs.

Adoption process is the change that takes place within individual with regards to an innovation from the moment that they first become aware of the innovation to the final decision to use it or not. However, as emphasized by Ray (2001), adoption does not necessarily follow the suggested stages from awareness to adoption; trial may not always practiced by farmers to adopt new technology. Farmers may adopt the new technology by passing the trial stage. In some cases, particularly with environmental innovations, farmers may hold awareness and knowledge but because of other factors affecting the decision-

making process, adoption does not occur. Dasgupta (1989) indicate that, the decision to adopt an innovation is not normally a single instantaneous act, it involves a process. The adoption is a decision-making process, in which an individual goes through a number of mental stages before making a final decision to adopt an innovation. Decision-making process is the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward an innovation, to a decision to adopt or reject, to implementation of new idea, and to confirmation of the decision (Ray, 2001).

The adoption or rejection of an innovation is the consequence of diffusion of an innovation (Ray, 2001). Diffusion is a process by which new ideas are communicated to the members of a social system (Roger and Shoemakers, 1971). An innovation is an idea, method or object which is regarded as a new by an individual, but which is not always the result of recent research (Van den Ban and Hawkins, 1998). Diffusion and adoption are thus closely interrelated even though they are conceptually distinct (Dasgupta, 1989).

Not all innovations diffuse at the same rate. The differences in the diffusion rates of innovations in a community can be largely explained by the differences in the traits of innovation, as perceived by potential adopters such as: relative advantage, compatibility, complexity, trial ability and observability (Dasgupta, 1989; Ray, 2001).

The adoption pattern to a technological change in agriculture is a complex process. A large number of personal, situational and social characteristics of farmers have been found to be related to their adoption behaviour. According to Dasgupta (1989) and Ray (2001), adopters have a high rate of literacy and higher level of formal education, operate large sized holdings, own the land they operate, have a relatively high income and economic status, are commercial in farming operation, have relatively high level of extension contact, and belong to upper socio-economic status categories. On the other hand, non-adopters have a low rate of literacy and level of formal education, operate smallholdings, are mostly small and marginal farmers, belong to low income group, have a low level of socio-economic status categories.

2.3 Technology Evaluation by Farmers

In many countries, extension recommendations are being developed by researchers on experiment stations which are aimed at maximizing the yields per unit of land area. Experimentation in the form of on-farm research is tried out in farmers' fields and evaluated based on agronomic performance and economic viability. This yield-oriented approach often brings forth recommendations that are irrelevant to farmers for two main reasons (Franzel and van Houten, 1992).

First, the recommendations are developed under physical conditions different from those of farmers, since they are generally formulated based on the results of experiments conducted on research station with modern farm management practice is to ensure a significant response from the experimental variables. Second by, the researchers' criteria for evaluation of new technologies are often to maximize yields or profit (Farrington and Martin, 1988; Franzel and van Houten, 1992), whereas farmers seek to maximize their welfare in addition to yield for food supply to their family. Small farmers in Ethiopia generally seek to provide a reliable supply of food for their families and provide cash for what they regard as essential purchases (Franzel and van Houten, 1992). Farmers may have different priorities depending on their socio-economic position, or sex, or age, and their preferences may change over time, for example, due to change in household situation or in market conditions (van Veldhuizen *et al.*, 1997).

Often those farmer-initiated activities have been unanticipated by professionals working in technology development and transfer. Many researchers feel that there is an element missing in research procedure that they should use to develop technology for small farmers. Farmers are active participants in the diagnosis and in testing new technologies proposed to solve or alleviate their problems. Researchers and farmers evaluate new technologies according to their acceptability and feasibility. Farmers are economically rational and they adopt new technologies that are in their interests and reject those that are not. When farmers resist a new technology, it is probably because it is not compatible with their objective, resources or

environment, not because of their backwardness, irrationality or management mistakes (Franzel and van Houten, 1992).

Farmers' assessment of the performance of trial technology is crucial and the most important part of technology evaluation. Farmers are rational in their decision-making Farmers will only decide to adopt technology if they are convinced of its benefits and if technology does not require unacceptable efforts on their part Therefore, involving farmers as active participants in the evaluation of recommended technological innovations can have several benefits for technology generation by agricultural research stations. This helps in getting a full understanding of the criteria farmers use to decide whether to adopt or reject recommendations (Bunders *et al.*, 1996).

Any technology or practice used by farmers represents a particular way to solve one or several problems. Each technology or practice responds to farmers' concerns in specific ways, which may be regarded as the traits or characteristics that define the technology or practice. Farmers can view some characteristics as positive or advantageous and others as negative or disadvantageous. Any practice or technology entails trade-offs between its positive and negative traits. The choice of one technology/practice over others is greatly influenced by the balance between its positive and negative characteristics. Depending on the preferences, resources, and constraints that individual farmers face, a beneficial characteristic for one farmer may be a negative one for another, or the balance between positive and negative traits may be acceptable for one farmer but not for another. Any new technology presented to farmers will either improve or substitute for the technological options they currently have. It is fundamental to identify these options and understand perceptions about the advantages and disadvantages of each one. Only then will researchers be able to assess the appropriateness of potential new technologies or practices, evaluate the likelihood that they will be adopted, and if necessary modify them to suit farmers' needs better. Farmers identify and select the type of crops most likely to do well in their areas. Selection is normally preceded by extensive discussions both within the farm family and with neighbours. Any family member may make observations of crop performance, looking at the crop during weeding or other activities and

noting any interesting variations. A good crop stand is often noticed by neighbours and becomes a subject of conversation within the community (Bunders *et al*., 1996).

Other authors also mentioned farmers' technology evaluation criteria such as growth habit, yield, colour of grain, main uses in the diet, processing and storage qualities, marketability (Farrington and Martin, 1988), cost, ease of sale, desirability for home consumption, compatibility with existing practices taste, nutritional value, cooking quality and resistance to pests (van Veldhuizen *et al*., 1997).

Farmers' criteria will vary greatly between households, depending on the productive resources controlled by the household. However, the criteria also vary within a household. The division of responsibilities and tasks is socially defined according to gender and age. This means that different household members will evaluate a technology according to different criteria, which are related to their role and functions in the household (van Veldhuizen et al., 1997).

Among the family members, women have the knowledge essential for seed selection because of their crop-related roles and tasks. They may be responsible for various crop husbandry tasks as well as for harvesting, and usually conduct all post- harvest operations such as processing, cooking, storage and use of crop residues. Women often insist on keeping some of the older varieties for home consumption because of their culinary qualities (Bunders *et al.*, 1996).

In many communities, women not only control crop processing but also look after the family grain store. Thus women may have a bigger influence and mainly use different criteria for selection (Chambers *et al*., 1989).

Varieties characteristics play a vital role in adoption of improved crop varieties. If the characteristics satisfied the need and interest of the farmers they will adopt. According to Dereje (2005) and Mahdi (2005) study on farmers' evaluation criteria of improved varieties, farmers put the following traits as select criteria; seed colour, large seed size, pest resistance,

draught resistance, ease of cooking, ease of threshing, good food quality, fodder yield, and attractive market demand.

2.4 Empirical Studies on Farmers Adoption Behaviour

Adoption of Green Revolution technologies has indicated that the new High Yielding Varieties (HYVs) were adopted at rapid rates in those areas where they were technically and economically superior to local varieties. Several studies have indicated that the adoption of improved varieties are affected by many factors such as farm size, age, family size, education, availability of credit, access to information etc (Dereje 2006).

Different people and institutions both outside and inside Ethiopia have conducted a number of empirical studies on the adoption and diffusion of agricultural innovations. But the studies are mainly concerned with major cereals and due to this reason studies conducted in the area of horticultural crops particularly onion is very limited. For ease of clarity the variables so far identified as having relationship with adoption are categorized as household personal variables, socio-economic factors, psychological variables and institutional factors.

2.4.1 Personal and demographic variables

These category variables are the most common household characteristics which are mostly related with farmers' adoption behaviour. Ages, sex, education, farming experience have reviewed in this study.

The stutudy conducted by Nkonya *et al*. (1997) on factors affecting adoption of improved maize seed and fertilizer in northern Tanzania, indicated that farmer's age did not significantly influence improved technology adoption. In contrary, the result of Million and Belay (2004) shows that age has significant by negative influence on the adoption of fertilizers. Shivani *et al*. (2000) also reported that more the experience of growing chickpea,

the higher the adoption of new varieties. Such a pattern is expected because more experienced farmers may have better skills and access to information about improved technologies.

Gender differentials are one of the important factors influencing adoption of improved agricultural technologies. Due to long lasted cultural and social grounds in many societies of developing countries, women have less access to household resources and also have less access to institutional services. Regarding the relationship of household's sex with adoption of agricultural technologies, many previous studies reported that household's gender has positive effect on adoption in favor of males. For example, Techane (2002), in his study on determinants of fertilizer adoption in Ethiopia found that male headed households are more likely to adopt fertilizer than female headed households. Similarly, Mulugeta *et al* (2001), reported that gender differentials among the farm households positively influenced adoption and intensity of adoption of fertilizer use at 5% significance level. They also further mentioned that being a male headed household increases probability of adoption by 5.9%.

The findings of Habtemariam (2004), Million and Belay (2004) Itana, (1985), Kansana *et al*. (1996), and Nkonya *et al*. (1997), indicated that farmer's education had positive and significant influence on adoption. Each additional year of education increases the probability of adoption of improved seed. Legesse (1992), and Degnet (1999) in their study stated that though education plays a significant role in the adoption decision, this variable was not found to be significant in affecting the decision to adopt improved technology.

Habtemariam (2004) found that the most efficient farmers appear to have less farming experience than the least efficient once. More experience is negatively related to adoption at older age. The result of Chilot *et al*., (1996) also indicated that farming experience does not matter in the adoption of improved wheat and coffee technologies.

2.4.2 Economic variables

Economic related variables such as farm size, off- farm activities, live stock ownership influence farmers' adoption behaviour. Concerning farm size the findings of Huque *et al*.

(1996), Nkonya *et al*. (1997), Bekele *et al*. (1998), Yishak (2005) reported that farm size exerts a positive influence on adoption of improved technologies.

Contrary to this study, Rahimeto (2007) and Taha (2007) were reported that land holding was not significant in adoption of improved haricot bean and onion technology package respectively. Off-farm and non-farm activities are the other important activities through which rural households get additional income. The income obtained from such activities helps farmers to purchase farm inputs. Review of some of the past empirical studies shows that the findings regarding the influence of off-farm/ non-farm income on adoption vary from one study to the other. However, majority of the studies reported positive contribution of off-farm and non-farm income to household's adoption of improved agricultural technologies. For instance, different technology adoption studies conducted by Kidane, (2001), Birhanu, (2002); Mulugeta *et al.*, (2001) and Mesfin, (2005) indicated positive relationship between off-farm income and adoption. Contrary to this, Techane (2002) in his study on determinants of fertilizer adoption in Ethiopia reported the negative influence of participation in off-farm income on farmers' adoption of chemical fertilizer.

Labour availability is the other important variable which in most cases has an effect on household's decision to adopt new technologies. Several studies reported the positive effect of household labour availability on adoption of improved agricultural technologies. For instance, Million and Belay (2004) in their study on factors influencing adoption of soil conservation measures in southern Ethiopia found positive effect of household's labour availability on adoption of soil conservation measures.

2.4.3 Institutional variables

Institutional variables are also having important role in influencing the behaviours of farmers contact in adoption of improved technologies. Institutional factors like frequent extension contact is positively related to the adoption decision of farmers (Jabbar and Alam, 1993; Chilot *et al*., 1996; Huque *et al*., 1996; Nkonya *et al*., 1997; Degnet, 1999; Tesfaye *et al*.,

2001; Habtemariam, (2004), and Kansana *et al*. (1996) in their study reported that the availability of reliable information sources will enhance communication process and had significant associations with adoption of improved technologies.

Legesse (1992), Chilot *et al.*, (1996), Kansana *et al*. (1996), Tesfaye *et al*, (2001) reported that access to credit had a significant and positive influence on the adoption of improved technologies. To the contrary of this study, Jabbar and Alam (1993) found that access to credit was not significant in their study of adoption rice technology.

A study conducted by Degnet (1999) in Mana and Kersa woreda, Ethiopia, showed that the number of oxen owned by a farmer determines maize technology adoption. The study has revealed that availability of off- farm income opportunity and wealth status of the head of household affects adoption of maize technology significantly.

Asfaw *et al*.(1997) in Bako area reported that participation of farmers in extension activities (which is represented by farmers attendance at the field days) is the only variable which is found to significantly influence the adoption of improved maize variety. The same study showed that the adoption of fertilizer technology in maize production is influenced positively and significantly by the farmers' use of credit and by the level of formal education of farm household head.

Tesfaye *et al*. (2001),) conducted a study on the adoption of high yielding maize technology in major maize growing regions of Ethiopia and the results revealed that distance to the nearest market centre, access to credit, significantly and positively influence the adoption decision of improved maize. The study conducted by Taha (2007) and Rahmeto (2007) on adoption of improved onion and haricot bean technology respectively has shown significant relationship to nearest market distance. However Shivani *et al*. (2000) reported that the distance to market is negatively related to chick pea adoption.

Participation in extension training will enable farmers to get more information and improve their understanding about the available packages, which may intern leads to a change in their

knowledge, attitude and behavior. According to Kansana *et al*., (1996) and Tesfaye *et al*., (2001), attendance of agricultural training is positively and significantly related to the adoption of improved maize technologies.

2.4.4 Psychological variables

Farmers' decisions to adopt a new technology in preference to other alternative technologies depend on complex factors. Farmers have subjective preference for technology characteristics which could play major role in technology adoption.

Adoption (rejection) of technologies by farmers may reflect rational decision making based up on farmers' perceptions of the appropriateness (inappropriateness) of the characteristics of the technology under investigation (Adesina and Zinnah, 1993).

Most of the work done on adoption behaviour focused on only independent variables. Duvel (1991) is perhaps the only researcher who did research on the psychological aspects of technology (innovation) transfer and adoption in South Africa. He developed a "revised extension program model'' which offers a big scope for improvement in extension directly influenced by a new approach towards behaviour change. In 1994 he also developed a model of technology transfer in agricultural development on the assumption that certain "intervening'' variables influence adoption behaviour directly, while the influence of more independent variables only shows its effect via the intervening variables. Further he also developed a model to determine adoption behaviour and found that personal and environmental factors are the independent variables, while needs, knowledge and perception are the intervening variables and adoption of practices and efficiency are the dependent variables. Non adoption of new technologies can be traced back to unwillingness or incapability (related to aspects of perception and knowledge) to adopt (Duvel, 1994).

Following Duvel, Habtemariam studied the influence of intervening variables on adoption behaviors and production efficiency in Ethiopia. Adoption behaviours and production efficiency were hypothesized to be a function of personal and environmental factors, which in

turn are divided into independent and intervening variables identified by Duvel (Habtemariam, 2004).

Empirical evidence provided by Duvel (1975) on the role of perception on behavior and behavioral consequences supports the assumption that the influence of the independent variables becomes manifested in behavior via the intervening or mediating variables. Subsequent findings by Louw and Duvel (1978) have reaffirmed that the mediating function of perception together with needs and knowledge.

Roling (1988) generalized that progressive farmers are more cosmopolites, eager for information; they are interested in extension advice; and have more homophiles with extension workers in that it is easy for them to communicate with each other. Farmers, who have awareness about the existence of the new technologies, continue in the search of further knowledge about the package to evaluate its importance so as to take further measures.

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2.5 Conceptual Framework of the Study

Agricultural technology adoption and diffusion patterns often vary from location to location. The variations in adoption patterns were created due to the presence of disparity in agro-ecology, institutional and social factors. Moreover farmers' adoption behaviour, especially in low-income countries, is influenced by a complex set of socio- economic, demographic, technical, institutional and biophysical factors (Feder et al, 1985).

Adoption rates were also noted to vary between different group of farmers due to differences in access to resources (land, labor, and capital) credit, & information and differences in farmers' perceptions of risks and profits associated with new technology. The direction and degree of impact of adoption determinants are not uniform; the impact varies depending on type of technology and the conditions of areas where the technology is to be introduced (Legesse, 1998).

Farmers' decision to adopt or reject new technologies can also be influenced by factors related to their objectives and constraints. These factors include farmers' resource endowments as measured by (1) size of family labors, farm size and oxen ownership, (2) farmers' socio–economic circumstance (age, and formal education) and (3) institutional support system available for inputs (CIMMIYT, 1993).

In many developing countries, it has become apparent that generating new technology alone has not provided solution to help poor farmers to increase agricultural productivity and achieve higher standards of living. In spite of the efforts of National and International development organizations, the problem of technology adoption and hence low agricultural productivity is still a major concern (CIMMIYT, 1993).

In this study efforts were made to figure out factors affecting intensity of adoption, the pattern and direction of adoption of improved onion varieties that varied according to farmers' personal characteristics, accessibilities to different services such as credit, extension, information market and Psychological factors.

Moreover literature, practical experiences and field observations have confirmed that technology adoption by farmers' can be enhanced in a sustainable manner by understanding those factors influencing the pattern, degree and direction of adoption and by designing and establishing technologies diffusion and adoption pattern strategies through farmers empowering, increasing farmers access to infrastructure, information, credit, field support, etc and acquainting them about how to utilize the technology.

Farmers' participation in technology development, and dissemination strategies as well as result evaluation should be considered, because farmers have long years of farming experience and acquaintance with environmental conditions. The need and interest of farmers' towards agricultural innovations also varies depending on farmers' farming environment, their belief, experience, economic status and their personal background. Therefore, disseminating improved agricultural technologies without consultation of farmers most probably ends with failure.

Practical experiences and observations of the reality have shown that one factor may enhance adoption of one technology in one specific area for certain period of time and may create hindrance for other locations. Because of this reason, it is difficult to develop a one and unified adoption model in technology adoption process for all specific locations. Therefore the type of technology that fits for all should not be accepted by technology users due to their different situations. Hence, the conceptual framework presented in Figure-1 shows the most important variables expected to influence the intensity of adoption of improved onion varieties in the study area. The arrows indicate in conceptual frame work the expected relationship between the variables.

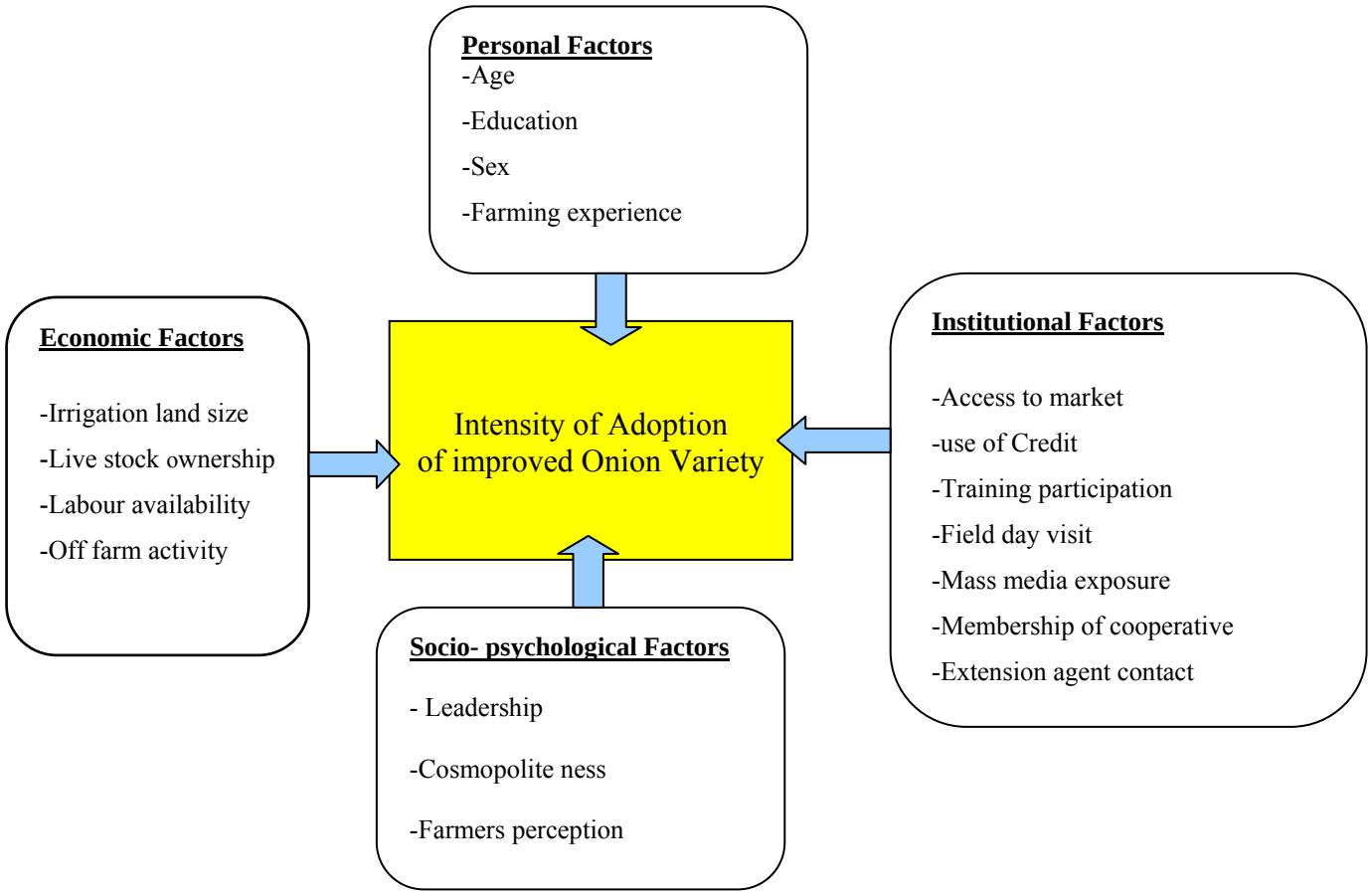

Figure 1: Conceptual framework of the study.

3. METHODOLOGY

3.1 Description of the Study Area

Fogera is one of the 126 rural districts in the region and one of the ten in the zone, South Gondar. It has an area of 117,405 hectares comprises of 25 rural *Kebeles*. A total population of 233,529 of which 42,746 households engaging in agriculture are living in the district. The capital is called Woreta and is located at the North t on the main road to Gondar from Bahir Dar.

The district is known for its plain nature where flat land accounts nearly 76 percent. The mean annual rainfall is 1216.3 mm, with short and long cropping seasons. Its altitude ranges from 1774 up to 2410 meter above sea level that allows a favourable opportunity for wider crop production and better livestock rearing (IPMS, 2005). The current land use pattern includes 43.8 percent cultivated land, 23 percent grazing land, 19.9 percent water bodies and the rest for others (IPMS, 2005). Most of the agricultural land is allocated for annual crops where cereals cover 52,759.99 hectares; pulses cover 9819.98 hectares; oil seeds 6137 hectares; root crops 1034.29 hectares; and vegetables 882.08 hectares (CSA, 2005). The major crops include tef, maize, finger millet and rice in order of area coverage. According to IPMS (2005), average land holding is about 1.4 ha with minimum and maximum of 0.5 and 3.0 ha, respectively.

Agricultural production in the district is mainly rain fed far from its wide irrigation potential. Being one of the eight district bordering Lake Tana, Fogera shares a water body of 23,354 hectares from the total lake size. Its plain topography created an opportunity for a good size of irrigation potential. In reality water lodging is the common phenomena in the plain areas.

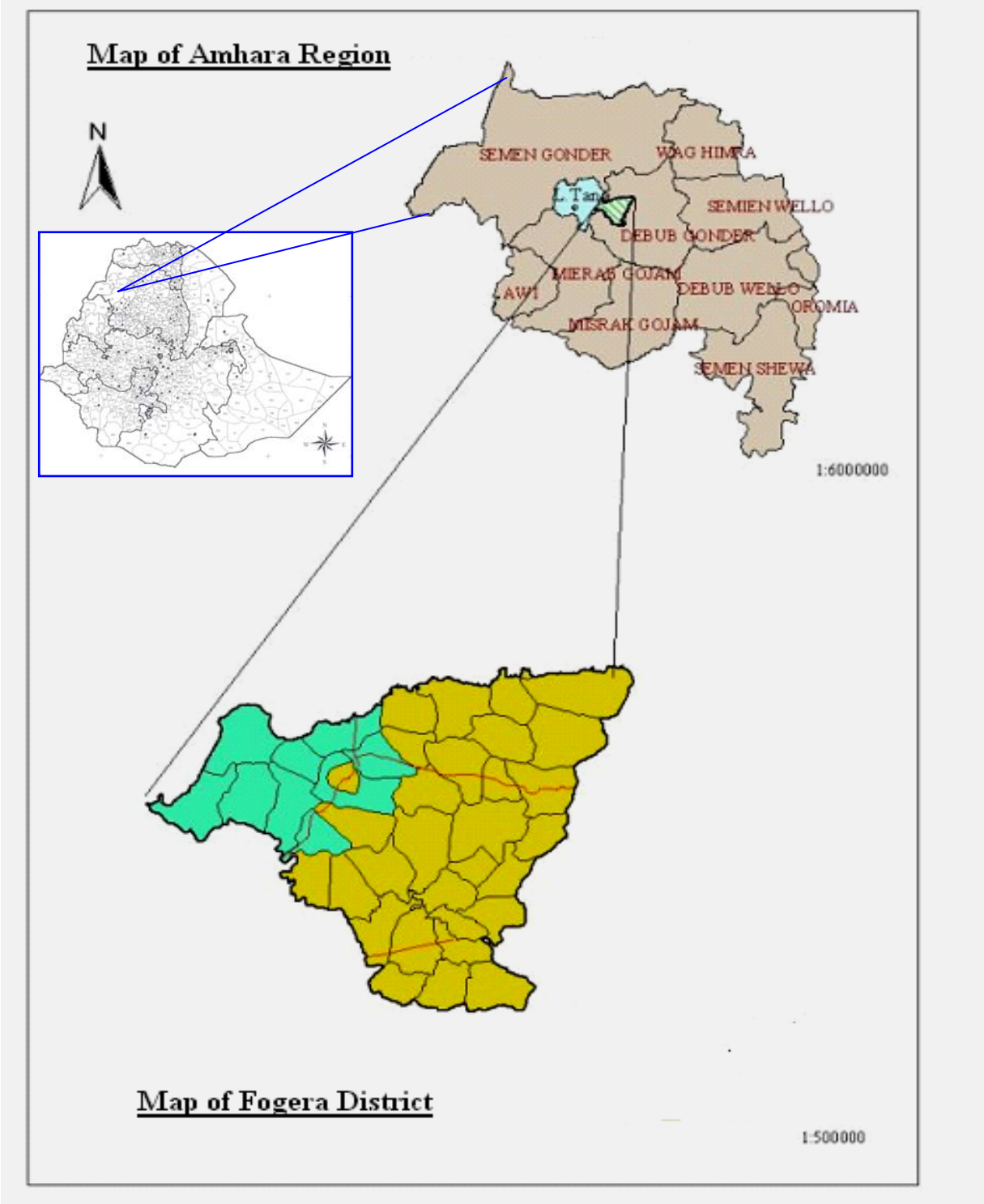

Figure 2. Map of the Study Area

Source: Regional Bureau of agriculture and rural development

3.2 Sampling Procedure

In this study a two stage sampling technique was employed. The first stage was purposive selection of onion growing *Kebeles*, followed by selection of sample households. The *Kebele* identification was made through reviewing secondary data on production and area coverage of the onion crop. All eight onion growing *Kebeles* were purposively selected as a sample out of the total 25 *kebels* of the district. After preparing fresh list of the sampling frame households were determined based on probability proportional to size of total onion growing farmers in each *Kebele.* Adopters and non adopters were selected randomly following simple random sampling technique. The total sample size for the study was 140 sample households and out of which 111 are adopters and 29 are non adopters. The main concern of this study is to find out factors influencing the intensity of adoption of improved onion production package, the larger portion (80%) of respondents of the total sample households was taken from adopters. The rest 20% of respondents were taken from non adopter households.

Table 1: Number of onion cultivators selected from each identified *kebeles*

S.no	Name of the keble	Total Number of onion growing households	Sample h household s selected
1	Woreta zuria	213	9
2	Aba kokit	383	17
3	Bebekis	1127	50
4	Kuhar Micheal	255	11
5	Wagetera	447	20
6	Kidst Hana	234	11
7	Shina	362	15
8	Rib Gibril	170	7
	Total	3191	140

Source: Fogera district office of agriculture, 2008

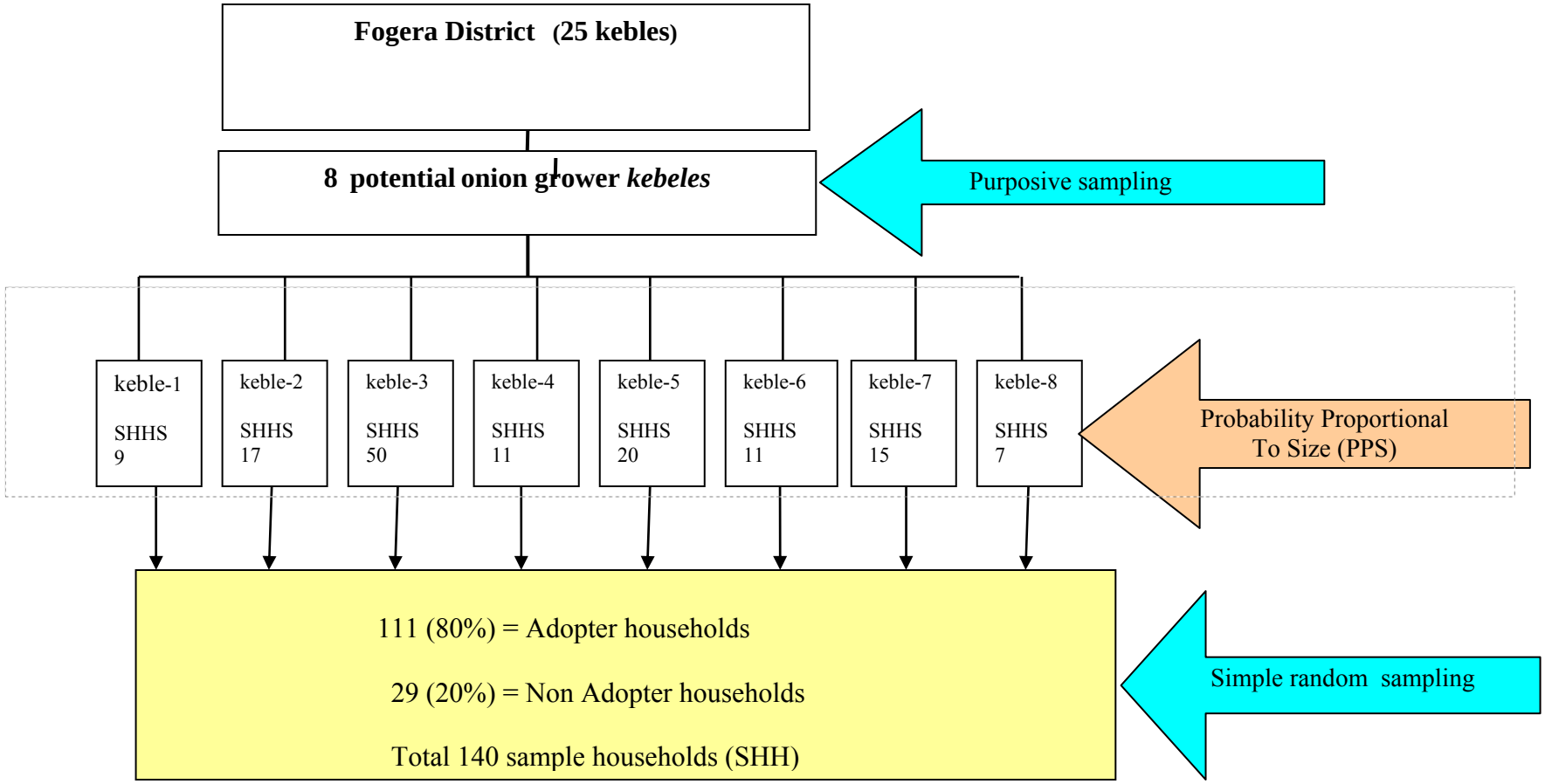

Figure 3 : Sampling procedure

3.3 Data type, sources and data collection methods

Primary and secondary data were collected to answer the research questions and achieve the objectives of this study. Additional number information about determinants of intensity of adoption and farmers' evaluation criteria of improved onion varieties including demographic, socio-economic, environmental situations, credit facilities, extension service and other relevant data having direct or indirect bearing on the study were gathered from sample households using interview schedule and in two group discussion. Relevant data were also gathered by examining secondary sources such as documents, reports and records maintained at DAs (Development Agents) office, and district agricultural office.

In this regard, primary data were collected through personal and face-to-face interview using structured and pre-tested interview schedule that were filled up by recruited and trained enumerators under the close supervision of the researcher. Totally, 140 randomly selected sample household heads were covered under the survey.

Qualitative information was also recorded from selected respondent farmers in view to have the right output from the survey work. Collection of primary qualitative information was managed through holding discussion with focused group and individual farmers. To ensure validity of the qualitative data, information was cross checked through conducting discussion with development agents and the district agricultural office staffs of the study area. Finally primary data were supplemented with secondary data in order to ensure adequacy and reliability of information gathered.

3.4 Definition of variables and hypotheses

Dependent variable: The dependent variable in this study is adoption index (AI) which indicates intensity of adoption of improved onion package. Adoption index in this case is a continuous dependent variable. Intensity of adoption refers to adoption index indicating farmers' level of use of multiple practices from the recommended improved onion production package.

Independent (explanatory) variables: The explanatory variables of importance in this study are those variables, which are thought to have influence on intensity of adoption of improved onion production package. These include household's personal and demographic variables, economic variables, household socio-psychological variables and institutional variables. These explanatory variables are defined as follows:

1. mass media exposure: Mass media plays an important role in the adoption of agricultural technology. Access here is defined as an ownership of any of the two mass media. A person who has an access to Radio or TV will be given a value of 1 and similarly the one who has no access to either of the two will be given a value of 0. Access to Radio & TV is expected to have positive influence on the adoption and intensity of adoption of improved onion variety by the farmers, (Kidane 2001).

2. Access to credit: Access to credit enables in the farmers to adopt the technology which otherwise may not be affordable for him. It is a dummy variable, which takes the value 1 if the farm household uses credit and 0 otherwise. Use of credit will influence adoption of vegetable production package positively,(Teressa 1997) and (Legesse1992).

3. Access to market: Access to market was hypothesized to be positively related to the probability of adoption of innovation. If the households located near to market tend to buy improved agricultural inputs and they can have easy access to sell their product in the market. Therefore, the variable was treated as a dummy variable in that if the household has an access to market has coded as 1and 0, otherwise. As market distance increases adoption and intensity of adoption was expected to decrease,(Dereje 2006) and (Rahimeto 2007).

4. Contact with extension agent: This refers to the number of contacts farmer had with extension agent to take advice in last cropping season. Therefore extension contact is hypothesized to have a positively influence on farmer's adoption of improved onion production package. It is believed that frequent contacts will enhance the exposure of farmers about improved onion production package,(Abrhaley 2007 and (Kidane 2001).

5. Farmer's age – Farmers age and adoption of technology are associated. As the farmer's age increases, it was expected that farmer become conservative. Therefore it is hypothesized that farmer's age and adoption are expected to relate negatively. As farmer age increases probability of adoption is expected to decrease, Dereje (2006) and Rahmeto (2006).

6. Perception: It is a continuous variable measured on five-point scale and refers to the superiority of the technology in terms of its advantage and compatibility with farmers circumstances. Respondents will rate the advantage of each package practices on five point scale based on their perception about the relative advantage of each package practices. The total perceived relative advantage of the package will be the sum of the scores for each package components. Therefore, total perceived relative advantage of improved onion production package was supposed to positively and significantly influence adoption and intensity of use of improved onion production package,(Ibrahim 2005).

7. Farming Experience: measured in number of years since a respondent started farming on his own. Experience of the farmer is likely to have a range of influences on adoption. Experience will improve the farmer's skill in production operations. Higher skill increases the opportunity of not undertaking the traditional enterprise. Farmers with higher experience appear to have often full information and better knowledge and are able to evaluate the advantage of the technology,(Chilot 1994).

8. Sex of the household: is nominal variable used as dummy (1 if male, 0 female). Gender difference is found to be one of the factors influencing adoption of new technologies. Due to many socio-cultural values and norms, male have freedom of mobility and participation in different extension programs and consequently have greater access to information. Therefore, it is hypothesized that male farmers are more likely to adopt onion package, (Taha 2007) and (Mesfin 2005).

9. House hold head education: This represents the level of reading and writing and formal schooling attended by the household head. It is expected that educated household head can

make better decision to adopt improved onion varieties than non-educated ones. Here, education extends from read and write to attending regular school education. In this study this variable was treated as a dummy variable and h as coded if the household head can read and write as well as attended the regular school education as 1 and 0, otherwise. Adoption is expected to correlate positively as education increases (Girmachew 2005) and (Derje 2006).

10. Cosmo politeness- is the degree of orientation of the respondents towards outside the social system to which he/she belongs. It is measured in terms of frequency of visits to outside the village. Cosmopolite ness is expected to have positive relationship with the dependent variable since it provides more chance of exposure to external information, (Derbe 2006).

11. Labor availability – those farmers who have access to labor are expected to adopt innovation more than those who lack labor accessibility since improved technologies required more labor. The variable has been treated as continuous variable measured by man equivalent of the family labour. As labor accessibility increases, adoption is also expected to increase and correlate positively, (Yishak 2005).

12. Livestock ownership: – Households that have more large number of livestock are likely to adopt more innovations than others who have less number of livestock because the farmers with more number of livestock have better opportunity to get credit. In this study it was assumed that livestock ownership and adoption would be related positively. As livestock ownership increases adoption/intensity of adoption is expected to increase and correlate positively,(Birhanu 2002) and (Endrias 2003).

13. Off-farm employment: Off- farm employment increases the additional income of the household and develops the capacity to invest in technology adoption. It is a dummy variable that takes a value of 1 if the farm household members participate in off-farm activities and 0 otherwise. Participation in off-farm activities will be expected to positively influence farmers' adoption decision, (Dereje 2006) and (Rahimeto 2007).

14. Participation in cooperative society: Cooperatives serve as an important source of credit and input. Due to this, a farmer who is a member of cooperative has more chance to get credit farm input. It is a dummy variable which takes value 1 if a person participates and 0 other wise. Therefore, being member of cooperative farmers will be expected to have positive and significant relationship with adoption of improved onion variety,(Taha 2007).

15. Leadership status of the respondent: - Those farmers who have experience of leadership and better social status are more likely to adopt onion technologies than others who do not have such experience. The variable was coded as 1 if farmer has leadership qualities and experience and, 0 other wise. Therefore it was assumed that such experience and exposure would increase the adoption of onion varieties positively, (Dereje 2005).

16. Participation in field days: It is measured by the number of times the farmer has participated in the field days in the last three years. Participation in field days is expected to positively influence farmers' adoption level of improved onion production package, (Edlu 2006).

17.Participation in training: Training is one of the means by which farmers acquire new knowledge and skills and it is measured by the number of times, the farmer has participated in training in the last three years. Hence, participation in training is expected to positively influence farmers' adoption behaviour, (Dereje 2006).

18. Size of irrigable land: It refers to the size of land under irrigation and measured in hectare. A farmer who has relatively large plot of land can rent part of his land to run his vegetable production activity. Therefore, the size of the irrigation land will positively affect level of adoption improved onion production package, (Taha 2007).

Table 2. Summary of Explanatory Variables

Variable	Variable code	Operational definition of the variable
Access to mass media	MEDIA	It is a dummy variable. A person who has access to Radio or TV will be given a value of 1, and similarly an individual who has no access to either of two will be given a value of 0.
Access to credit	CREDIT	A dummy variable, with value 1, if a person has access to credit and 0 otherwise.
Access to market	MAKET	A dummy variable, with value 1 if a person has access to market and 0 otherwise.
Contact with extension agent	EXTCON	it is measured as the number of times the farmer has made contact with extension agent in the last cropping season.
Farmer Age	AGE	Refers to age of the household head in years given with the rational numbers.
Farmers Perception on recommended practices	PERCEP	A continuous variable, Perceived relative advantage and disadvantage of the technology attributes are measured by scores
Farming Experience	FAREXP	A continuous variable measured by years of experience.
Sex, HH	SEX	A dummy variable with value 1 if the household head is male and 0 otherwise.
House hold head Education	EDUHH	A dummy variable with value 1 if the household head can read and write as well as attending the regular school and 0 otherwise.
Cosmopolite ness	COSMOP	It is measured in terms of frequency of visits outside his social system.
Labour accessibility	LABOR	A continuous variable measured by man equivalent of the family labour.
Livestock Owned	LIVOWN	Total number of livestock owed by a household measured in tropical livestock unit (TLU)

Variable	Variable code	Operational definition of the variable
Off farm employment	OFFEMP	A dummy variable with the value 1 if the household members engaged in off-farm employment and 0 otherwise.
Participation in cooperative society	COOPS	A dummy variable with the value 1 if the household or one of the members participated in cooperative society and 0 otherwise.
Irrigable Land Size	LANDSZ	Irrigable land size owned in hectares
Leader ship status	LEADER	A dummy variable, with value 1 if a person has leader ship experience and 0 otherwise
Participation in field days	FIELDAY	It is measured as the number of times the farmer has participated in field day during the last three years.
Participation in training	TRAIN	It is measured by the number of times the farmer has participated in training during the last three years

3.5 Analytical Techniques

Descriptive statistics often fail to predict the combined effect of the explanatory variables on the dependent variable (Aldrich and Nelson, 1984). Thus, this gap is to be bridged by the help of selecting and using appropriate econometric models.

One objective, i.e., objective 2 of this study was achieved by employing econometric model to predict the influences of the explanatory variables on the dependent variables, which is factors influencing the intensity of adoption of improved onion production package.

The focus of the study with regard to this objective is to analyze the factors influencing the decisions of households to grow improved onion production package. The response to questions such as whether a household has used in his field the whole set of onion production package or not, could be a yes or no answer, which is a typical case of dichotomous dependent variable. Thus, the model suggested for analysis of such a dependent variable is the Tobit model.

In view of this, adoption index which shows to what extent the respondent farmer has adopted the whole set of package was calculated using the following formula.

In order to identify the level of adoption of improved onion production package, adoption index of individual farmer was calculated as follows.

$$AI_i = \sum_{i=1}^{n} \frac{\left[\frac{AHi}{ATi} + \frac{FAi}{FRi} + \frac{WAi}{WRi} + \frac{IAi}{IRi} + \frac{SRAi}{SRi} \right]}{NP}$$

Where: i=1, 2, 3……n, and n= total number of farmers

Np = No of practices

AI_i= Adoption index of the i^{th} farmer

AH_i= area under improved variety of onion of the i^{th} farmer

AT_i= Total onion production area (improved variety+ local, if any) of the i^{th} farmer

FA_i= amount of fertilizer applied per unit of area in the cultivation of improved variety of onion by i^{th} farmer,

FR= Amount of fertilizer recommended for application per unit of area in the cultivation of improved variety of onion,

WA_i= Frequency of weeding and cultivation used by i^{th} farmer

WR= Recommended number of weeding and cultivation for improved onion production

SRA_i= seeding rate used by i^{th} farmer

SRi= amount of seed rate recommended per unit of area.

IA_i= number of irrigation applied by the i^{th} farmer, and

IR= Number of irrigation recommended for the crop

The adoption index (AI) varies from 0 to 100% depending up on farmer's degree of adoption of the technology. On the basis of adoption index respondent farmers were classified in to three categories, viz., low, medium and high adopter.

Adoption index is thus a continuous dependent variable which is affected by different factors to be investigated. Tobit model is used to identify the different factors affecting farmers' level of package adoption.

The Tobit model

Tobit model is an extension of probit model and it is one of the approaches dealing with the problem of censored data (Johnston and Dandiro, 1997). Some authors call such model limited dependent variable model, because of the restrictions put on the values taken by the regressand (Gujarati, 1995). Tobit model is superior over other dichotomous regression models in that the later only attempts to explain the probability of adoption or non adoption of technologies by the farm households rather than the intensity or extent of adoption. However, knowledge of farmers who are using improved varieties may not provide much information about farmers' behaviour.

The farmer may adopt only some part of the recommended package practices and may also do this on 1% or 100% of his/her farm. So, Tobit model is more appropriate to give reliable output of both discrete and continuous variable combination. In consequence, this model out put gave information for both probability and intensity of adoption of improved onion production package.

Many professionals conducted adoption studies in Ethiopia used the Tobit model to identify determinants of probability and intensity of different technologies in different locations. For instance, Taha (2007) used the Tobit model to identify determinants of intensity of adoption of improved onion production package. Rahimato (2007), has also used the Tobit model to identify determinants of adoption of haricot bean production package. In the same line Dereje (2006) used the Tobit model to identify intensity of adoption of improved bread wheat with his research entitled as assessment of farmers' evaluation criteria and adoption of improved bread wheat varieties.

Model specification

Following Maddala (1992),Amemiya (1985) and Johnston and Dandiro (1997), the Tobit model for the continuous variable adoption index, can be defined as:

$AI_i^* = B0 + BiXi + Ui$

$AI_i = AI_i^*$ if $B_0 + B_iX_i + U_i > 0$.....(1)

$= 0$ if $B_0 + B_iX_i + U_i \leq 0$

Where:

AI_i= is adoption index for ith farmer

AI_i^*= is the latent variable and the solution to utility maximization problem of intensity of adoption subjected to a set of constraints per household and conditional on being above certain limit,

Xi= Vector of factors affecting intensity or level of package adoption,

Bi= Vector of unknown parameters, and

Ui= is the error term which is normally distributed with mean 0 and variance σ^2.

The model parameters are estimated by maximizing the Tobit likelihood function of the following form (Maddala, 1997 and Amemiya, 1985).

$$L = \prod_{AI_i^*>0} \frac{1}{\sigma} f\left(\frac{AI_i - \beta_i X_i}{\sigma}\right) \prod_{AI_i^*\le 0} F\left(\frac{-\beta_i X_i}{\sigma}\right) \qquad (2)$$

Where f and F are respectively, the density function and cumulative distribution function of AI_i^*. $\prod_{AI_i \le 0}$ means the product over those i for which $AI_i^* \le 0$, and $\prod_{AI_i > 0}$ means the product over those i for which $AI_i^* > 0$.

An econometric software known as "Limdep" was employed to run the Tobit model. It may not be sensible to interpret the coefficients of a Tobit in the same way as one interprets coefficients in an uncensored linear model (Johnston and Dinardo, 1997). Hence, one has to compute the derivatives of the estimated Tobit model to predict the effects of changes in the explanatory variables.

As cited in Maddala (1997), Johnston and Dinardo (1997) and Nkonya *et al*. (1997), McDonald and Moffit (1980) proposed the following techniques to decompose the effects of explanatory variables into adoption and intensity effects. Thus; change in X_i (explanatory variables) has two effects. It affects the conditional mean of AI_i in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. Similarly, in this study, the marginal effect of explanatory variables was estimated as follows.

1. The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\partial E(AI_i)}{\partial X_i} = F(z)\beta i \qquad (3)$$

Where, $\frac{\beta_i X_i}{\sigma}$ is denoted by z, following Maddala, (1997)

2. The Change in the probability of adopting a technology as independent variable Xi changes is:

$$\frac{\partial F(Z)}{\partial X_i} = f\,(\mathrm{z})\frac{\beta_i}{\sigma} \qquad (4)$$

3. The change in the intensity of adoption with respect to a change in an explanatory variable among adopters is:

$$\frac{\partial E(AI_i / AI_i^* > 0)}{\partial X_i} = \beta_i\left[1 - Z\frac{f(z)}{F(z)} - \left(\frac{f(z)}{F(z)}\right)^2\right] \qquad (5)$$

Where,

F (z) is the cumulative normal distribution of Z,

$f(z)$ is the value of the derivative of the normal curve at a given point (i.e., unit normal density),

Z is the z-score for the area under normal curve,

β is a vector of Tobit maximum likelihood estimates and σ is the standard error of the error term.

Before running the Tobit model all the hypothesized explanatory variables were checked for the existence of multi-collinearity problem. There are two measures that are often suggested to test the existence of mulit-collineality. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables. In this study, variance inflation factor (VIF) and contingency coefficients were used to test multicollinearity problem for continuous and dummy variables respectively.

According to Maddala (1992), VIF can be defined as: VIF (X_i) = $\frac{1}{1-R_i^2}$,Where R_i^2 is the quared multiple correlation coefficient between X_i and the other explanatory variables.

The larger the value of VIF, the more troublesome. As a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if R_i^2 exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995). Similarly, contingency coefficients were computed for dummy variables using the following formula.

$$C = \sqrt{\frac{\chi^2}{n+\chi^2}}$$

Where, C is contingency coefficient, $\chi 2$ is chi-square value and n = total sample size.For dummy variables if the value of contingency coefficient is greater than 0.75, the variable is said to be collinear (Healy, 1984 as cited in Mesfin, 2005).

4. RESULTS AND DISCUSSION

4.1 Introduction

This study intended to examine the farmers' evaluation criteria and adoption of improved onion production package in the study area, *Fogera,* as well as to know the effects of hypothesized independent variables on the dependent variables. In this section of analyses descriptive statistics such as mean, standard deviation, percentage, frequency tabulation, F-test and chi-square test were employed using SPSS- 12 computer soft ware program.

In this study, adopters of a technology refer to farmers who adopt an improved variety with some of the recommended practices of onion production package. Those farmers who experienced growing of local variety known as shallot were considered as non adopters. Among these seven practices only five practices (improved variety, seed rate, fertilizer application, cultivation and weeding, and irrigation frequency) are currently practiced by onion growers in the study area. The rest two practices (spacing and chemical application) were not applied by growers in their farm. Due to this reason only five practices were used to calculate the adoption index. Adoption index score was calculated by adding up the adoption quotient of each practice and dividing it by number of adopted practices of each respondent's. The adoption quotient of each practice was also calculated by taking the ratio of actual rate applied to the recommended rate.

The overall adoption index of all sample households was categorized into four distinct categories, that is, none, low, medium, and high adoption level. The actual adoption index score ranges from 0 to 1. The adoption index score 0 point implies non adoption of improved onion production package and the adoption index score greater than 0 to 1 grouped among different adoption categories. The adoption index score of 1 implies the respondents adopted all practices according to the recommendation. If the adoption index score become above the value of 1, it indicates that the respondents used some of practices above the recommendation rate. To evaluate the significance of the relationship between dependent and independent

variables and to test the hypothesis Chi-square and F-test were used. To see the strength and direction of association among variables Cramer's V and Pearson correlation were applied.

4.2 Some realities of onion production in the study area

The following information was collected from farmers' group discussion, the development agents working in sampled *kebeles* and from district agricultural office technical staffs.

4.2.1 The common practices of onion production

In e *Fogera* district, the cropping season for onions begins in the month of October, after the off set of the rainy season. Most farmers choose to prepare their seedbeds during the dry season because most part of their land during the rainy season is over-flooded with rain water. The farmers prepare the seedbeds with great care. Once the seedbeds have been prepared, the farmers level the seed bed and distribute the seeds evenly across the surface of the bed. The seed bed is then watered and covered with grass or leafy branches of tree. The seeds germinate within 6 to 8 days after planted. Management of the seedbed needs careful operation. Approximately a week after germination, the seedbed must be weeded. This is a time consuming task and requires patience. The farmers must be careful to water the onion seedlings when necessary. After the seedbeds have been planted, the farmers prepare the land where the onion seedlings will be transplanted.

The seedlings will be ready to be transplanted is 45 days after germination. First, the seedlings are pulled from the seedbed and placed in a basket made from local material. Usually they are covered with something to keep the delicate stems from direct sun rays. The labour for this task is separated by gender. The men make the holes following the rows for the plants, and they irrigate the rows before planting. The women and children plant the onions in the muddy rows, which must be kept wet to reduce high soil temperatures and facilitate the transplanting process. Transplanting onion seedlings is tedious and backbreaking work.

Onion farmers in the study area do not keep the recommended spacing. They do not have any measurement to keep the spacing between plants and rows. Because of this there is no specific distance between both rows and plants. The distance between rows and plants is varying. Both sexes perform this task with amazing proficiency, the men are able to work long hours in making rows and watering the rows. Men and women are putting the thin stems of the seedlings of onion into the wet soil. In comparison with other local crops, such as maize, the tillage and planting requirements for onions are much more labour intensive.

After the transplanting has been completed, the farmers must monitor field conditions cautiously. Timely irrigation of the early crop is essential. Two weeks after planting, the farmers begin the first important weeding operation. The hoe is also used to remove any emerging weeds. Some farmers will apply the first urea fertilizer during this period. Both male and female labourers do this task.

The second weeding operation is done after 4 to 5 weeks of transplanting. Once this final mechanical operation has been completed, the farmers' primary concerns are timely irrigation to maintain adequate soil moisture and conducting a careful assessment of the onion field to control insect pests and diseases.

As onion bulbs increase in size, the onion leaves begin to collapse. This occurs 80 to 120 days after planting, depending on the variety. During the harvesting time labour is divided by gender. Men dig out the onion bulbs with a pick and make piles of the plants. The women and children cut the foliage from the onion and package the bulbs in large sacks. This operation is one of the very labour-intensive activities of onion production.

4.2.2 Onion marketing

After onion has been harvested and bagged, farmers are primarily concerned with getting their crop to market and the day-to-day fluctuations that occur in the market price. The primary constraints to profitability for onion farmers in the district are poor post-harvest and marketing techniques.

Almost all farmers in the district did not apply post-harvest techniques to improve the marketability of their crop. Farmers do not cure/treat onions to increase the shelf life. These untreated onion bulbs have fresh, open wounds at the neck where the green foliage was cut from the bulb. Such wounds, combined with poor handling techniques cause the onions to decay quickly once they have been bagged for transport. Some onions will sprout green foliage after only several days. Others will become infected by various decay-causing organisms, which quickly rot the inside of the onion and make it unfit for sale. Farmers have a short period of time to get their crop to market. They are, therefore, more susceptible to fluctuations in the market price, as they do not have the comfort of waiting time until the price has reached a satisfactory level.

Onion will pass through different hands many times from the moment it leaves the farm until it arrives to the consumers. In the study area, there are three primary ways in which an onion crop is transported to the town. The first and most frequent one is a bagged onion is loaded on donkey back; the second one is women loaded on their back and men loaded on their shoulder. The third one is a lorry known as Isuzu can load some products directly from the individual farms. Often times the Isuzu loading is in contact with the middle men through telephone. The middlemen visit different farms and try to buy recently harvested onions. Since the farmers have a limited time to store the onion bulbs they are subjected to sell their products with minimum price for the middlemen. Sometimes a group farmers rent a lorry and transport their onion bulb to the nearest town market to avoid the market sabotage of middlemen.

Onion farmers in the study area have three market outlets from *Woreta* town: These are Bahir Dar 55 km to South, Gondar 120 km North, and Debretabor 45km to East of Woreta town. The major problems of onion marketing are unsatisfactory pricing where the wholesalers were mostly benefited and controlled the market, lack of functional organization among producers, the existing six irrigation cooperatives establishing with the aim of administering vegetable marketing do not have skill how vegetable marketing handled and how to increase their bargaining power; inadequate market information for producers was also another market

problem mentioned in the study area. Every market information especially output price information first reaches to middle men. Because of this the poor farmers were always remain in the hands of these middlemen in selling their products.

4.3 Current Status of Adoption of Intensity of Improved Onion Production Package

To know the level of adoption of each sample household's adoption index score was calculated by adding the adoption quotient of each seven practice of improved onion production package. The adoption quotient of each practice was also calculated by taking the ratio of actual rate applied to the recommended rate, which indicates the extent to which an individual farmer has adopted the package practices.

In the study area some of the recommended practices were not practiced by sample households. Only those package practices which were used by sample households were included into the adoption index. These include adoption of a variety, seeding rate, fertilizer application rate, weeding and cultivation frequency, and irrigation frequency. The sample households' index scores were categorized into four adopter groups' namely non adopter, low, medium and high adopter. The actual adoption index score ranges from 0 to 1. Adoption index score of 0 point implies non-adoption of the overall improved onion production package.

One way analysis of variance indicate that there is significant difference (F=575.993, P=.000) among the adoption index score of the four adoption categories at 1% significance level which indicates variation in level of adoption among sample farmers (Table 3).

Table 3: Distribution of respondents by level of adoption of improved onion production Package

Adoption category	N	Percent	Adoption index score range	Mean	SD	F value	P value
Non adopter	29	20.7	0.0	0.00	0.00		
Low	33	23.6	0.01-0.33	0.21	0.06		
Medium	69	49.3	0.34-0.66	0.52	0.08		
High	9	6.4	0.67-1.0	0.67	0.02		
Total	140	100	0-1.0	0.30	0.23	575.993***	0.00

Source: Own survey data, 2008; *** = the mean difference is significant at 1% level.

As depicted in Table 3, the nearly half of the sample respondents lies in the medium adopter category and comprises 49.3% of the total sample households with the mean adoption index score of 0.52. This indicates that their overall package adoption level is less than the recommended rate. Most of the sample households have used the practices such as seeding rate and fertilizer application rate below the recommended rates. Contrary to this, farmers' adoption of other practices such as irrigation frequency and cultural operations were found to be almost the same to the recommended rates of the research system. Unfortunately spacing, one of the important practices is totally neglected and not put in to practice by all adopters. The reason why they neglect keeping the recommended spacing is that it consumes more labour and time to practice it in the field. Farmers' deviation from the recommended practices could be associated with several factors to be discussed in the coming sections.

4.4 Current Practices of Improved Onion Production Package

Farmers' current practices of the seven components of improved onion production package components are discussed here below.

4.4.1 Improved onion varieties

Bombay Red variety is the most preferred and widely grown in the study area.The intensity of variety adoption is measured in area covered by improved variety of onion. The area coverage was varying among onion growing sample households. As indicated in Table 4, the total sample households' average area coverage was 0.49 hectare. The minimum and maximum area coverage by adopter sample households is ranging from 0.12 to 1.5 hectare. One way analysis of variance (F=27.670, P=0.00) revealed that there is significant mean difference among adopter categories at 1% significance level. The difference in area coverage under improved onion variety may be attributed to varying land holding and stage of an individual in the adoption process.

Table 4: Distribution of sample households by the area coverage under improved onion Variety

Adoption category	N	Mean	SD	F value	P value
Low	33	0.45	0.25		
Medium	69	0.47	0.24		
High	9	0.59	0.45		
Total	111	0.49	0.32	27.670***	0.000

Source: own survey, 2008 ***= the mean difference is significant at 1% level

4.4.2 Seeding rate

Seed is considered as a critical input contributing significantly to agricultural production. Using quality seed, proper seeding rate and appropriate time of planting are the most important practices in improved onion production. Excessive or under utilization of seed will result in poor plant population and leading to low production.

As a rule, research recommends specified level of seeding rate, seed quality and time of planting for a given variety of crop. Technology promoters also advice farmers to adopt the recommendation as it are. Farmers' use of the recommended seeding rate however depends on several factors including their own criteria. Availability of quality seeds and other household related socio-economic factors also influence adoption decisions. Farmers in the study area were found to use varying seeding rates ranging from 1 to 10 kg per ha, the maximum seed rate used by farmers is above two fold of the recommended rate (3.5-4.0 kg/ha) of the research system.

Table 5: Average seeding rate applied by sample adopter households in kg/ha.

Adopter category	N	Mean	SD	F value	P value
Low	33	2.81	1.10		
Medium	69	3.38	2.12		
High	9	5.66	1.78		
Total	111	2.269	2.23	40.610***	0.00

Source: Own survey, 2007, ***=. the mean difference is significant at 1% level.

On an average low, medium, and high adopters used 2.81, 3.38, 5.66 kg/ha respectively. Except the high adopter groups the average seed rate used by sample households is below the recommendation rate. There was a significant variation among the sample households in the amount of seed rate per unit area used where the minimum was 1 kg, while the maximum was 10 kg per ha.

One way analysis of variance revealed the existence of significant mean difference in seeding rate applied among the three adopter categories, low, medium and high (F=40.610, P=.000) at 1% significance level (Table 5).

Even though the average seed rate used by respondents is below the recommendation rate there are few sample households applied more than recommendation rate. The main reasons for using such high seeding rate was the supply of poor quality seed by different seed dealers. Hence, to ensure appropriate plant population farmers used more than the recommendation rate.

In 2006/07 production year the onion growers average seed cost incurred per ha in one production season was about 416.95 birr. In the same year the seed purchase price was ranges from 125-185 birr.

Starting from the year 2005 there are few individuals (26) engaged in seed production business. The seed from local producers was relatively better quality, than the seed procured from other dealers outside. That is why 89.2% of the sample households preferred individual local producers as a seed source (Table 6). It is surprising to note that cooperative was utilized by negligible number of respondents for procuring onion seed. This reflects the inefficient functioning of cooperative in performing its role.

Table 6: Sources of onion seed for sample households in 2006/2007 production year

Seed source	Frequency	Percent
Local market	7	6.3
Cooperative	5	4.5
Individual producer	99	89.2
Total	111	100

Source: own survey, 2008

4.4.3 Fertilizer application rate

Regarding fertilizer application, it was found that very few (38) number of respondents of the total (111) adopter sample households applied chemical fertilizer in their farm plot. During group discussion, farmers mentioned that they prefer to use fertilizer in nursery sites than field plots. However, farmers in the study area use varying fertilizer doses, which in most cases is below the recommended rate (Table 7).

The average rate of fertilizer applied by sample households during the 2006/07 production year was 110.52 kg/ha. The maximum amount of fertilizer used was 200 kg per hectare while the minimum was 100 kg per hectare. Fertilizer application rate of sample respondents vary across adopter categories. Statistical analysis of ANOVA showed that there was significant mean difference (F=15.293, P= .000) in fertilizer application rate among adopter categories at 1 % level of significance (Table 7). The recommendation rate set by the research system is ranging from 100 to 200 kg/ha.

Table 7 : Average fertilizer rate applied (Kg/ha) by sample households (n=38)

Adoption Category	N	Mean	SD	F value	P value
Low	13	88.46	21.92		
Medium	16	93.75	25.00		
High	9	172.22	26.35		
Total	38	110.52	42.16	38.120	0.000

Source: Own survey, 2008; *. The mean difference is significant at 1% level.

During the group discussion, interesting facts were brought to the focus by the respondents. They believe that their farm land is relatively fertile and therefore there is no need to follow the recommendations. Even with less doses of fertilizer the crop yields can be optimized.

4.4.4 Spacing

To avoid nutrient competition sufficient spacing between plants and rows is vital to get maximum yield in given plot of land. Appropriate spacing enables the farmer to keep appropriate plant population in his field. Hence, a farmer can avoid over and less population in a given plot of land which has negative effect on yield. The research system was recommended spacing for improved onion production as 10X20X40 cm spacing where 10 cm is spacing between plants, 20 cm between rows and 40 cm is the size of plant bed including irrigation water path used for irrigating the plant (Lemma, 2004).

In the study area the recommended spacing was not practiced by all adopter sample households. Farmers transplant seedlings in the field with undetermined spacing. The spacing between rows and plants is determined by individual farmer just in the process of transplanting as per his own idea and perception.

During group discussion farmers pointed out that, practicing the recommended spacing in the `field is impossible due to its additional labour and time requirement. It is discouraging to note that, this practice of improved onion package is totally rejected by all sample households.

4.4.5 Cultivation and weeding

Cultivation and weeding are cultural operations frequently practiced by onion growers. Cultivation is done to loosen the compacted soil around the plant root while weeding is very important to avoid nutrient competition.

Table 8: Distribution of adopter respondents according to use of cultivation frequency

Adoption category	Frequency	Percent	Mean	SD	F value	P value
Low	33	29.7	2.15	0.364		
Medium	69	62.2	3.23	0.622		
High	9	8.1	4.11	0.333		
Total	111	100	2.98	0.798	66.230***	0.000

Source: own survey, 2008, ***= the mean difference is significant at 1% level.

Timely cultural operation is one of the important practices of improved onion production package. According to the research recommendation, the number of cultural operations which can be practiced in one growing period of a crop is 2-3 times. The first cultivation should be carried out 15 days after transplanting, while the second after 30 days and the third after 50 days of transplanting to loosen the soil around the root zone (MoARD, 2005).

According to the survey result, majority of sample farmers (70.3 %) performs more than three times cultivation while the rest 29.7 % performs two times cultivation in a production season. On an average total sample adopter households performed 2.98 numbers of times of cultivation in a production season (Table 8). The result seems convincing and satisfactory. These reflect that respondents have understood the benefits of intercultural operations leading to follow the research recommendations.

4.4.6 Chemical application

In the study area chemical application was not used by almost all sample households. As depicted in Table 9. Very few sample households practiced chemical application only in the nursery site. During group discussion farmers expressed that none of them have used chemicals to onion field in 2006/07 cropping season.

Further there was no insect pest attack on the onion crop both in nursery and field. This implies that the prevalence of insect pest and diseases of onion crop in the study area is very low. Farmers have articulated in the group discussion that, thrips (the most common onion insect) was identified in some onion fields with very low severity.

Table 9: Chemicals application in onion crop by adopter sample households in Kg/ha

Adoption category	N	Mean	S D	F	P
Low	0	0	0.0		
Medium	8	1.81	1.19		
High	4	2.00	0.81		
Total	12	1.87	1.04	0.078NS	0.785

Source own survey, 2008 NS= Non Significant

The result of the survey indicated that out of the total of 111 adopter sample households only 10.8% of them used chemicals in the nursery site. It was noted that only medium and high adopters have practiced this components of the package. The research recommendation for fungicide chemical application is 3.5kg with 600 litre water per hectare.

The result of analysis of variance revealed that there was no significant difference (F=0.078, P=0.785) in average amount of chemical (fungicide) applied among the adopter categories (Table 9).

4.4.7 Frequency of irrigation

In the study area, onion production is practiced under irrigated conditions. Furrow irrigation method is mostly used to irrigate the onion fields. The sources of water for irrigation are rivers and stream water. Significant number of onion growers have water pump to pull out water from all the water sources.

Table 10: Distribution of adopter sample households by the irrigation interval per week

Adoption category	N	Mean	SD	F value	P value
Low	33	1.03	0.18		
Medium	69	1.36	0.57		
High	9	1.63	0.51		
Total	111	1.29	0.51	4.822***	0.003

Source: own survey, *** = the mean difference is significant at 1% level

With regard to irrigation frequency the research recommendation is to irrigate the onion field 2 times per week for the first three weeks and at 5-7 days interval then after. However, in the recommendation it was also mentioned that the frequency could vary depending on the nature of the soil and weather condition (MoARD, 2005).

As indicated in Table 10, the total average number of times of irrigation used by total sample households is 1.29 times per week. The minimum frequency is 1 times per week and the

maximum frequency is 2 times per week. After three weeks of transplanting the sample households practiced to irrigate the field within 8-10 days interval. Hence, the number of times of irrigation frequency used by farmers is more or less closer to the research recommendation.

4.5 Farmers' Evaluation Criteria of Improved Onion Varieties

To improve onion production, the agricultural research system of the country has made efforts to generate improved varieties. As a result of this effort the varieties Adama red, Bombey red, Red creole, Melkam, Mermiru brown and Nasik red (Dereselegn) are made available to farmers (Lemma and Shimelis, 2003).

Many of these varieties are introduced to the farming community through different development workers, especially through government agricultural extension system professionals. However among six released verities of onion, only Bombay red and Adama red verities are widely adopted in different part of Ethiopia.

Despite the efforts of extension system, adoption of improved onion varieties in the study area is still low.The district office of agriculture substantiates the low level of adoption with information that, the overall adopter population in the sampled *kebles* is accounted for 7.3% of the total households that owned irrigated land. The rest 92.7 % of households owning irrigated land grow different crops like, tomato, pepper, cabbage, potato and carrot. As to the status of adoption of improved onion varieties, the survey result indicated that 98.2 % of adopters are currently growing Bombay red variety while 1.8 % sample households are growing Adama red (Table 11).

Even though better efforts made to promote Adama red variety by the research and extension systems, Bombey red is the most widely grown variety at present in the study area.

As indicated in Table 11, below among the total sample adopters (n=111) the majority of the sample households preferred to grow Bombay red starting from the year 2000 to 2007 and

the number of sample households growing Bombay red were also increasing. Those farmers who grow Adama red variety were very few and the numbers of sample households were continuously decreasing from year 2000 to year 2007.

Table 11: Distribution of the sample adopter households by years of cultivation of improved onion varieties

Year	Bombay red		Adama red	
	Frequency	Percent	Frequency	Percent
2000	99	89.1	12	10.9
2001	105	94.5	6	5.5
2002	105	94.5	6	5.5
2003	106	95.4	5	4.6
2004	108	97.2	3	2.8
2005	109	98.1	2	1.9
2006	109	98.2	2	1.8
2007	109	98.2	2	1.8

Source: own survey,2008

Farmers have their own preference criteria for adoption among the released varieties, which in most cases not considered by research and extension people. The fair majority (98.2 %) of sample farmers preferred Bombey red for its early maturity, yield advantage and other favored attributes. In the study area Adama red variety is ready to harvest 5 months duration while Bombey red takes only 4 months after transplanting. The respondents mentioned that the longer time of maturity had an implication on their production cost and they lags behind to plant the second crop after onion harvest. Today the importance of understanding farmers' technology preference becomes a crucial issue by the research and extension system. Significant numbers of technologies disseminated to farmers are simply rejected by farmers due to mismatch with preference criteria between technology disseminator and farmers. The study results accommodated in Table 12 below clearly indicate that the farmers consider 6 attributes in deciding their preference criteria (evaluation) for adoption of variety.

Table 12: Variety selection criteria ranking and variety preference by adopter sample households

no	Variety selection criteria	Frequency	Percent	Rank	number of respondents by their variety preference		
					Bombay Red	Adama Red	Total
1	Earliness	44	39.6	1st	111	0	111
2	Yield	26	23.4	2nd	90	21	111
3	Bulb size	23	20.7	3rd	80	31	111
4	Bulb colour	11	9.9	4th	75	36	111
5	Seedling Vigour	4	3.6	5th	49	62	111
6	Storage capacity	3	2.8	6th	41	70	111
	Total	111	100				

Source: own survey, 2008

In view of that, early maturity, good bulb size, better yield, bulb colour, vigour seedling production for ease of transplanting, and better storage capacity most preferred attributes of improved onion varieties in order as ranked by sample households (Table 12).

During group discussion farmers mentioned that, early maturing variety reduces their cost of production and gives an opportunity to plant the second crop on the same plot after its harvest. Good bulb colour and bulb size are important attributes as per the market demand. Vigour seedling production was an important attribute which creates workable atmosphere at the time of transportation to field. Better storage capacity was also other preferred attributes which reduces loss on account of distress sale. In conclusion the research and extension system of the country has to give more attention to participatory research which considers farmers' technology preference. As indicated in Table 12, most of sample households prefer Bombay red as best variety with its important attributes of early maturity, good yield, bulb size and bulb colour.

Adama red is selected as best with its vigour seedling production for ease of transplanting and for its better storage time. In general Bombay red is the first preferred variety whereas Adama red is second preferred variety.

The other point mentioned by the farmers during group discussion is that, major reasons why non adopters are not growing improved onion varieties are: the bulb of local variety has more pungency effect than the improved one, the local variety has better storage time, the bulb of the improved variety is easily wounded and susceptible to decay during transportation and growing the improved variety is more labor intensive than the local one. This is because local variety of onion is directly planted to the field without prior preparation of seedlings in the nursery site. The planting material for local variety is the bulb itself and planting the bulb in the field is easy for farmers as compared to transplanting the seedlings of the improved onion variety..

4.6 Effects of Explanatory Variables on Intensity of Adoption of Improved Onion Production Package

Modern agricultural technologies are usually recommended in a package form to disseminate for farmers. But the general opinion of agricultural development agents and other professionals who has a close contact with farmers is that farmers are not ready to accept all recommended practices as it is. Farmers usually accept and apply in their farm field only certain practices of the technology package due to many reasons.

This condition leads to create diversity among farmers in their level of package adoption. Variation among respondent's households of this study could be related to: personal characteristics, economic, social, and institutional factors. Hence identifying the variation due to influencing factors of adoption of onion production package is the main objective of this study. Table 3 in the previous pages illustrates the sample respondents in to four distinct categories.

As shown in Table 3, the mean adoption index score of non-adopters, low, medium, and high adopters are 0.00, 0.21, 0.52, and 0.67 respectively. One way analysis of variance revealed

that there is a significant mean difference (F=575.993, P=.000) among the adoption index score of the four adoption categories at 1% level.The sample households who scored 0.01-0.33 categorized into low, 0.34-0.66 and 0.67-1.0 scores were categorized into medium and high adoption level respectively. Above all the larger share of adopter categories lies on the medium adoption level which comprises of 49.3 % of the sample households. The second larger share of adopter categories lies on the low adoption categories with 23.6 % of the sample households. The non adopter and high adopter categories consisted of 20.7 % and 6.4% of the sample households respectively.

4.6.1 Personal and demographic characteristics

In order to understand the sample households, it is very important to describe their demographic characteristics. The numbers of household head respondents were selected from eight Rural *Kebele* Administrations. Out of the total 140 respondents in the sample 14 respondents were women and the rest 126 were men. The distribution of sample households in each sample *Kebele* administrations by sex and adoption category are depicted in Table 13 below.

Table 13: Distribution of selected households by sex, *kebele* and adoption category

Name of the Kebele	Adoption category					Sex sample HH		
	Non adopter	Low	Medium	High	Total	Male	Female	Total
Woreta Zuria	2	2	4	1	9	9	0	9
Aba kokit	4	4	8	1	17	16	1	18
Bebekis	11	11	25	3	50	46	4	50
Kuhar Michael	2	3	5	1	11	9	2	12
Wagtera	4	5	10	1	20	17	3	20
Kidist Hana	2	2	6	1	11	9	2	9
Shina	3	4	7	1	15	13	2	15
Rib gebrel	1	2	4	0	7	7	0	7
Total	29	33	69	9	140	126	14	140

Source: own survey,2008

4.6.1.1 Age of the household head

The role of age in explaining technology adoption is somewhat controversial. It is usually considered in adoption studies with the assumption of that older people have more farming experience that helps them to adopt new technologies. On other side, because of risk averting nature older age farmers are more conservative than the youngest one to adopt new technology. The risk of vegetable producers arises from high cost of production, out put market price fluctuation and very low storage time of the products. Due to this fact age was hypothesized to have negative relationship with the adoption of improved onion production package.

As portrayed from Table 14, the total average age of respondents was, 44.01 years with the standard deviation of 11.06. The maximum age of the respondents 65 years while the minimum age was 23 years. One way ANOVA analysis was run to check whether there is a significant mean difference in age between adopters and non-adopters.

The result of F-test showed that there was no significant mean difference (F=.0.384, P= 0.765) among adoption categories implying the absence of significant relationship (Table 14). The studies of Dereje (2006) and Rahmeto (2007) on assessment of farmers evaluation criteria and adoption of improved bread wheat varieties in Akaki district and determinants of adoption of improved haricot bean production package in Alaba special district respectively were also reported the absence of relationship between age and adoption of new technologies.

Table 14: Relationship between age, family size, and onion farming experience of respondents with level adoption of improved onion package

Variables	Adoption category	N	Mean	SD	F value	P value
Age of the respondent	Non adopter	29	42.93	13.09		
	Low	33	43.88	9.87		
	Medium	69	44.86	11.14		
	High	9	41.44	8.02		
	Total	140	44.01	11.06	0.384 NS	0.765
Family size	Non adopter	29	5.59	1.95		
	Low	33	5.76	2.06		
	Medium	69	5.94	1.57		
	High	9	5.22	1.56		
	Total	140	5.78	1.77	0.602 NS	0.615
Onion farming experience	Non adopter	29	0.0	0.0		
`	Low	33	3.76	1.41		
	Medium	69	4.36	2.01		
	High	9	5.67	3.84		
	Total	140	4.29	2.11	2.051 NS	0.110

Source: own survey result, 2008, NS= Non Significant

4.6.1.2 Family size

Family size in the study is considered as the number of individuals who resides in the respondent's household. Large family size assumed as an indicator of labour availability in the family. Based on this fact this variable was hypothesized to have positive and significant relationship with adoption of onion production.

As shown in Table 14, the average family size of the respondents was 5.78 members. The minimum family size of the sample households was 2 while the maximum was 11 persons. The results show that there is no significance mean difference among the adopter categories

(F= 0.602, p=0.615). This is because of the fact that most onion growers have experienced shared labour to overcome labour shortage, especially during transplanting, weeding and cultural operations of the crop.

4.6.1.3 Onion farming experience

Experience of the farmer is likely to have a range of influences on adoption. Experience will improve the farmer's skill at production. A more experienced farmer may have a lower level of uncertainty about the innovation's performance. Farmers with higher experience appear to have often full information and better knowledge and are able to evaluate the advantage of the technology considered. Therefore, it was hypothesized that onion farming experience has a positive influence on adoption of improved onion production technologies.

With regard to the study sample, the minimum onion farming experience of sample households was 2 and the maximum was 15 years. On an average the sample households had 4.26 years of experience in onion farming. The average years of onion farming experience for low, medium, and high adopters were 3.76, 4.36, and 5.67 years respectively (Table 14).

As depicted in Table 14 the results of this study is in contrast to the assumption, where farming experience was expected to have positive relationship to the adoption of onion production package**.** Farming experience has no significant mean among adoption categories (F= 2.051,p=0.110) and the result of bivariate correlation analysis test showed that there is no relationship of farming experience with adoption of onion production package (r =1, p= 0.117.). The result is in line with the findings of Rahimeto (2007) and Chilot (1994).

4.6.1.4 Educational status of Sample household heads

Education is very important for the farmers to understand and interpret the agricultural information coming to them from any direction. A better educated farmer can easily understand and interpret the information transferred to them by development agent.

Table 15: Relationship between Education of the household head and adoption level of improved onion package (%)

Education status	Adoption category				Total	χ^2
	Non adopter	Low	Medium	High		
Illiterate	82.7	69.6	60.8	22.3	65	
Literate	17.5	31.4	39.2	77.7	35	
Total	100(29)	100(33)	100(69)	100(9)	100(140)	12.097***

Source: own survey, 2008, (χ^2=12.097, P=0.007, df=3, Cramer's V=0.294), *** = Significant at 1% probability level

As indicated in Table 15 from among the sample households, 65% were illiterates and 35% were literates. In this study the literacy was extended from read & write to attending regular school education. To see the relationship and the intensity of relationship, the chi-square- test was conducted. The result of chi-square- test (χ^2=12.097, P=0.007) revealed that there is significant difference between education and the adoption of improved onion production package.

The result of this study is in agreement with the studies conducted by Taha (2007) reported significant relationship of education with the adoption of improved onion production package. Similarly Addis (2007) and Mahdi (2005) reported positive and significant relationship of education with the adoption of technology.

4.6.1.5 Sex of household head

Gender difference is found to be one of the factors influencing adoption of new technologies. Due to many socio-cultural values and norms males have freedom of mobility and participation in different meetings and consequently have greater access to information. So, sex was hypothesized to influence adoption in favour of male head household.

Table 16: The relationship between sex of the household head and the adoption of onion Production Package

	Adoption category								Total	
	Non adopter		Low		Medium		High			
Sex	N	%	N	%	N	%	N	%	N	%
Male	25	86	25	76	67	97	9	100	126	90
Female	4	14	8	24	2	3	0	0	14	10
Total	29	100	33	100	69	100	9	100	140	100

Source: own survey, 2008, (χ2=12.768, df=3, Cramer's V=0.502, P=0.005)

As described in Table 16 out of 140 respondents, 90% were male and the rest 10% were female. The majority of female adopters were found in low adoption category which indicates that they are less capable in adopting onion production packages as compared to their male counterparts. The result of chi-square analysis (χ^2=12.768, P=0.005) revealed that there is significant relationship between sex and the adoption of onion production package at 5% level.

The result of this study is in a complete agreement to many of previous researchers who have reported positive effect of gender with adoption of agricultural technologies. Taha (2007), in his study on determinants of intensity of adoption of improved onion production package in Dugda Bora district found that male households are more likely to adopt onion production package at 1% significance level.

4.6.2 Resource ownership of the sample households

The relationship between adoption category with the variables of total land holding, land covered with improved onion variety, irrigable land size, livestock ownership, water pump ownership and labour availability are discussed here below.

4.6.2.1 Total land holding

Land is the main asset of farmers in the study area. Farmers in the study area use both their own land and also rent farm land for crop production .All 140 sample households selected in the sample have their own land. The distribution land holding of the sample households is illustrated in Table 17.

The average total land holding of the sample households were 1.34 hectare. The minimum and maximum total land holding of the respondents ranges from 0.25 to 2.5 hectares. The total average land used for improved onion crop production by respondents was 0.39 hectare. The average total land holding of the non adopters group was 0.69 ha whereas the low, medium and high adopter categories was 1.48, 1.52, and 1.56 ha respectively. One way analysis of variance (F=19.537, P=0.000) statistical analysis revealed mean difference statistically among adoption categories at less than 1 % level. The result of this study is in harmony of the past findings of Mulugeta, 2000; Yishak, 2005 and Mesfin, 2005.

Table 17: The relationship between land resources owned by respondents with adoption of improved onion production package

Land in hectare	Adoption category	N	Mean	S D	F value	P value
Total land holding	Non adopter	29	0.69	0.42		
	Low	33	1.49	0.55		
	Medium	69	1.53	0.50		
	High	9	1.56	0.74		
	Total	140	1.34	0.61	19.537***	0.000
Land covered by improved onion variety	Non adopter	29	0.00	0.00		
	Low	33	0.45	0.25		
	Medium	69	0.48	0.24		
	High	9	0.59	0.45		
	Total	140	0.39	0.30	27.670***	0.000
Irrigable land size	Non adopter	29	0.44	0.29		
	Low	33	0.49	0.28		
	Medium	69	0.54	0.28		
	High	9	0.65	0.46		
	Total	140	0.52	0.29	1.305	0.275

Source: own survey data computations, *** = significant at 1% level

4.6.2.2 Irrigable land size of sample households

In the study area most of vegetables are grown under irrigated conditions. In rainy season most the sample households farm land is highly flooded with rain water due to high water retention capacity of the silt–clay soil nature of the area. Rice is the main crop that covers significant size of flooded farm land. Immediately the rainy season is over and the rice crop harvested, most farmers plant the onion crop under irrigation. Land renting and crop sharing is a common practice to get irrigable land for onion production.

Those farmers who have adequate amount of irrigable land are free from land rent costs. Likewise, a farmer who has large irrigable land can rent out part of his irrigable land to others to fetch money that can be used to purchase farm inputs for onion production. Sharecropping is also the other strategy used by the farmers who has no irrigable land for onion production. In this study, size of irrigated land was hypothesized to have positive and significant relationship with adoption of improved onion production package.

As showed in Table 17, the average irrigated land holding for the sample population is 0.52 ha. The minimum was 0.13 ha while the maximum is 1.5 ha. The average irrigated land holding for non adopters' category was 0.44 ha while for low, medium and high adopter group was 0.49, 0.54, and 0.64 ha respectively. The analysis of ANOVA (F=1.305, P=0.275) resulted in non significant relationship of irrigable land size with the adoption of improved onion production package. The result indicates that irrigated landholding is not decisive factor in adoption of improved onion production package. In the study area irrigable land is available through either renting or share cropping practices. In 2006/2007 cropping season, about 30.7% of respondents have rented- in irrigated land from those who did not grow onion in their fields and the rest 69.3 % of adopter sample households did not rented land (Table 18).

Table 18: Irrigated land rented- in by adopter sample households for onion production

Size of land rented in (ha)	N	Percent
0.00	77	69.3
0.13-0.33	12	10.8
0.34-0.99	17	15.3
1.0-1.5	5	4.6
Total	111	100

Source: own survey, 2008

4.6.2.3 Livestock ownership

In the study area mixed farming is practiced with crop and livestock production. Each household owns at least one or more types of livestock and a piece of land for crop and livestock production. Livestock in the study area provides traction power, manure and serves as a source of income through sale of animals and their products.

Table 19: The relationship between livestock holding (TLU) with the adoption of improved on production package

Adoption category	N	Mean	SD	F	P	r
Non adopter	29	5.7	4.87			
Low	33	8.12	4.38			
Medium	69	7.86	4.27			
High	9	6.88	3.33			
Total	140	7.42	4.43	2.015	0.115 NS	1.02

Source: own survey, 2008, N.S= Non significant

As confirmed by many studies, those farmers who have better livestock ownership status are likely to adopt improved agricultural technologies. In this study, ownership of live stock hypothesized to have a positive relationship with adoption of improved onion production. The average livestock ownership of sample households in TLU was 7.42.The minimum livestock number of the total respondents' was 3 whereas the maximum number of livestock was 19 in TLU as depicted in Table 19.

To know whether there is a variation in average livestock ownership between adopters and non- adopter's analysis of variance was conducted. The result of ANOVA (F=2.015, P=0.115) revealed that there is no significant variation in average livestock ownership within the adopter categories as indicated in Table 19.

The results of bivariate correlation analysis (r =1.02) indicated that there is no association between livestock holding and adoption of improved onion production package.

The results of this study are not in conformity with earlier adoption studies. For instance, Endrias (2003), Birhanu (2002), Taha (2007) in their studies reported that livestock holding has positive influence on adoption of agricultural technologies.

4.6.2.4 Ownership of water pump

Water pump is a vital farm input for onion growers in the study area. According to the information obtained from the district office of agriculture currently there are about 319 diesel water pumps in the district. Most of water pumps found in the study area were owned in share by two or three farmers. Generally 2 to 3 farmers form a group and purchase one water pump with money taken on credit. The group members' watering schedule priority is done with agreement. If all members of the group are not using of the water pump, they will rent the pump for others. For the time being the average rent of water pump in the study area was birr 7 per hour. The major source of irrigation water is river. Moreover underground water and the lake shore water is used by some of the sample households. And so, ownership of water pump was assumed to have positive effect on adoption of improved onion production package.

Table 20: Relationship between shared ownership of water pump and adoption of improved onion production package

Adoption category	water pump ownership in share		Total
	No	Yes	
Non adopter	82.8 (24)	17.2 (5)	100 (29)
Low	55.5 (18)	45.5 (15)	100 (33)
Medium	59.4 (41)	40.6 (28)	100 (69)
High	55.5 (5)	45.5 (4)	100 (9)
Total	62.8 (88)	37.2 (52)	100 (140)

Source: own survey, 2008, ($\chi 2 = 6.451$, df=3, Cramer's V=0.540, p=0.092) , ( ) = N

As depicted in Table 20, 37.2% of the total sample households had water pumps in common. From the non adopter groups, 17.2% of them had water pump. The largest numbers of water

pump owners were the medium adopters. The non adopter farmer group used the water pump to irrigate local shallot and tomato plot of land.

As was expected, chi-square analysis (χ^2 = 6.451, p=0.092) showed the significant relationship of water pump owned with adoption of improved onion production package. Therefore we can safely conclude that water pump plays a vital role in order to boost up the adoption onion production package in particular and vegetable production in general.

4.6.2.5 Labour availability

Onion production requires high labour force to get a better harvest from this crop. Farmers use family members and hired labour to fulfil the requirements. Farmers, who have such labour opportunity, generally adopt improved agricultural technology. In this study, it was hypothesized that labour availability to have positive relationship with adoption of onion production package.

Table 21: The relationship between labour availability and adoption of improved onion production package in man equivalent.

Adoption Category	N	Mean	SD	F value	P value	r
Non Adopter	29	3.31	1.17			
Low	33	3.61	1.20			
Medium	66	3.81	1.21			
High	9	3.85	1.30			
Total	140	3.66	1.18	1.396 NS	0.247	0.160

Source: Own survey, 2008. NS=Not Significant

The total average labour availability in terms of man equivalent for sample household was 3.66 with standard deviation of 1.18.

The average number of available labour force in terms of man equivalent for non-adopters, low, medium and high adopters were 3.31, 3.61, 3.81 and 3.85 respectively (Table 21). The

analysis of one way ANOVA (F= 1.396 and P = 0.247) shows the absence of significant mean difference between adoption categories, the result of this study confirms the earlier findings of Taha (2007) and Yishak (2005).

Table 22: Distribution of respondents by labour shortage and solution practiced for onion cultivation.

Labour shortage problem	Frequency	Percent
No	56	40.0
Yes	84	60.0
Total	140	100.0
Solution to labour shortage problem	Frequency	Percent
No problem	56	40.0
Hiring labour	15	10.7
Mutual for cooperation	40	28.5
Both hiring and cooperation	29	20.8
Total	140	100

Source: own survey data, 2008.

The above Table 22 indicates that 60 % of the respondents had labour shortage problem especially at time of practicing transplanting, cultivating, weeding and harvesting time. Hence, onion growers were using hired labour, using mutual cooperation and both hiring and cooperation as solution to overcome labour shortage.

4.6.3 Economic variables of the sample households

The relationship between adoption category with the variables of farm income and off-farm employment are discussed here below.

4.6.3.1 Farm income

Farm income is the main source of capital to purchase farm inputs and other household consumable goods.Farm income refers to the total annual earnings of the family from sale of agricultural produce after meeting family requirements. In this study the household farm income was estimated based on the sales of crop produce, and livestock and livestock products. The major cash income for sample households in the study area is from sale of

vegetable crops including onion. The average annual income from onion cultivation is presented in Table 23.

Table 23: Average annual income of respondents from sale of onion in Birr (n=111)

Distribution statistics	Income size (birr)
Mean	5914.26
SD	5348.64
Minimum	1200.00
Maximum	24080.00

Source: own survey data, 2008.

Table 23 indicates that the average cash income to the farmers from onion crop was 5914.26 birr with standard deviation of 5348.64. Onion production accounts for 37% of the average annual farm income of the sample households.

Table 24: Mean annual farm income of respondents across adoption categories (in Birr)

Adoption category	N	Mean	SD	F value	P value	r
Non adopter	29	9930.59	8625.70			
Low	33	15575.45	8716.06			
Medium	69	16666.97	11476.97			
High	9	17105.22	11526.23			
Total	140	15948.89	10800.86	4.222***	0.007	0.208**

Source: survey , 2008 , ***,** represents significant at 1% and 5 %probability level.

As depicted in Table 24, above, the average annual farm income for the total sample households was birr 15948.89, whereas the average farm income for non-adopters was Birr 9930.59 and that of low, medium and high adopters mean on-farm income was 15575.45, 16666.97 and 17105.22, respectively. The minimum and maximum farm income of the total sample households ranges from 1200 to 24080.

ANOVA analysis (F= 4.222 and p=0.0.007) was conducted to test the relationship of farm income with adoption of onion production package and test result showed significant mean difference among adoption categories. The bivariate correlation test result (r = 0.208) revealed the existence of positive and strong relationship between adoption of onion production package and annual farm income. The result of this study is in harmony with research findings of Kidane (2001), Taha (2007).

4.6.3.2 Off-farm employment

In most part of rural Ethiopia, off-farm employment is viewed as a transitory situation, and only considered necessary as income source for low earning farm community. In the study area, grain trading, vegetable trading, and daily labour were found to be some of the off-farm activities in which sample households were participating.

Hence those households who have got an engagement in off- farm employment are understood to raise their annual income. Therefore, in this study, it was hypothesized that there is a positive correlation between participation in off-farm activities and the adoption of onion production technologies.

Table 25: Relationship between participation in off-farm activities and adoption of improved onion production package (%)

	Adoption category				
Farmers response	Non adopter	Low	Medium	High	Total
No	100.0	90.9	91.3	88.9	92.8
Yes	0.0	9.1	8.7	11.1	7.2
Total	100(29)	100(33)	100(69)	100(9)	100(140)

Source: Source: Own Survey, 2008; χ2-value 2.884, Cramer's V= 0.144, df=3 p=0.410, NS= Non Significant.

As illustrated in Table 25, from the total sample households only 7.2 % participated in off-farm activities. Among the households who participated in off-farm activities, non adopters were not participated in off farm activities. Participation in off-farm activities had

insignificant relationship (χ^2= 2.884, df= 3, p=0.410) with adoption of improved onion production package. The result of this study confirms the findings of Rahimeto (2007).

4.6.4 Institutional factors

The relationship between adoption category with the variables of access to credit, contact to extension agent, mass media exposure, access to market, participation to cooperative society and attending extension visits are discussed here below.

4.6.4.1 Access to credit

Adoption of improved onion production package by farmers is motivated by the income gained from the sale of the produce. Farmers grow the onion crop not for consumption purpose only but to fetch cash income which is allocated for purchasing farm inputs and meet out other family needs. But constraints to adoption of improved onion production are numerous: the cost of a seed, high labour requirement and technical skill need for of crop management, are some of the constraints that hinder the adoption of this crop.

Farmers without cash and no access to credit will find it very difficult to adopt new technologies. Previous authors verified this preposition (Legesse, 1992; Teressa, 1997). It is expected that access to credit will increase the probability of adopting improved onion production package.

In this study too, this hypothesized preposition is supported by the significant relationships which exist between access to credit and adoption of the onion production package (χ^2 = 12.674, df = 3, P = 0.005) as shown in Table 26. This relationship is also reflected in distribution of percentage of respondents where only 13.8 of non adopters have access to credit while the percentage difference between low, medium and high adopters is not as high as the one between non adopters. But the high adopters' percentage declines as compared to low and medium adopters. This implies that high adopters have a better financial capital to purchase farm inputs which is reflected in the results.

Table 26: Relationship between access to credit and adoption of improved onion production Package (%)

Response of farmers	Adoption categories				Total
	Non	Low	Medium	High	
No	86.2	45.5	52.1	46.7	58.6
Yes	13.8	55.5	57.9	33.3	41.4
Total	100(29)	100(33)	100(69)	100(9)	100(140)

Source: own survey (2008), ( ) = N; $\chi^2 = 12.674$, df = 3, p = 0.005; Cramer's V = 0.303

4.6.4.2 Contact to extension agent

The major sources of agricultural information for farmers are extension agents. The frequency of visits or availability of extension services is perhaps the single variable that emerged significantly in most of the research work on technology transfer and adoption (Asfaw et al, 1997; Kedir, 1998). It is hypothesized that frequency and timely contact with extension workers will increase a farmer's probability of adopting technologies.

Table 27: Distribution of sample households by frequency of contact with extension agent (%)

Frequency of contact	Adoption category				
	Non adopter	Low	Medium	High	Total
No contact	51	24.2	7.2	0.0	20.0
Once in a week	0.0	3.0	8.7	22.0	6.4
Fortnightly	0.0	6.0	31.9	33.6	19.2
Only planting period	18.1	21.3	27.6	44.4	25.0
During input distribution	10.3	30.3	15.9	0.0	17.2
During credit collection	20.6	15.2	8.7	0.0	12.2
Total	100(29)	100(33)	100(69)	100(9)	100(140)

Source: survey result, 2008, (χ2=7.691, df =3, P=0.053), ( ) = N

The relationship between extension contacts and adoption of improved onion production package was found to be significant as shown in Table 27. From the total sample households, 20% were reported not having contact with extension agent, while 80% of sample households were reported having contact with the extension agent at different level of frequency. From the non adopter groups, 51% of respondent did not have any contact with extension agents.

The percentage of respondents not having contact with extension agent, larger share comes from the non adopters as compared to the respondents of adopter category.

The chi-square analysis result ($\chi^2 = 7.691$, $p = 0.053$) shows significant relationship of contact of extension agent with the adoption of onion production package. The earlier researchers, Girmachew (2005) ,Abrhaley (2007) and Kidane (2001) also reported similar result.

4.6.4.3 Mass media exposure

Mass media plays a great role in providing information in shortest time possible with coverage large area. As compared to other communication channels, its effect on behavioural change is weak as it mainly deals with awareness creation. Even though mass media is weak to bring change in human behaviour, it has a grate role in awareness creation for behavioural change. In this study farmers' exposure to mass media was measured by the ownership of radio or TV by sample households. In this study media exposure is assumed to have positive relationship with adoption of improved onion production package.

Table 28: Relationship of mass media access and adoption of onion production package (%)

	Adoption category				Total
Farmers response	Non adopter	Low	Medium	High	
No	37.9	33.3	23.2	33.3	29.3
Yes	62.1	66.7	76.8	66.7	70.7
Total	100(29)	100(33)	100(69)	100(9)	100(140)

Source: survey result,2008, ( ) = N; ($\chi^2 = 2.618$, df = 3, $p = 0.454$; Cramers'V = 0.137), NS= Non Significant

Table 28 shows that, 29.3% of the sample households did not have access to mass media while the majority (70.7%) of sample households reported to have access to mass media. However the result of chi-square analysis ($\chi^2 = 2.618$, $p = 0.454$) showed that there is no significant relationship between mass media with the adoption of onion production package. The result of this study is in line with Rahimeto (2007) and Kidane (2001). This implies that

Radio and TV station did not have appropriate agricultural program to transmit for rural community.

Table 29: Distribution of respondents by average distance travelled to reach the nearest market centre (in km).

Adoption category	N	Mean	S D	Min	Max	F value	P value	r
Non adopter	29	12.55	8.47	2	25			
Low	33	12.48	3.19	5	23			
Medium	69	12.42	6.10	2	25			
High	9	12.00	7.05	1	18			
Total	140	12.44	6.15	1	25	0.019	0.996 NS	-0.016

Source: survey result, 2008, NS=Non Significant

Regarding the distance travelled home to the nearest market place, sample farmers reported that they had to travel an average of 12.44 kms with standard deviation of 6.15 kms. Average distance travelled to reach the nearest market centres by non-adopters, low adopters, medium and high adopters was 12.55km, 12.48 km, 12.42 and 12.00 km respectively (Table 30).

Results of one way analysis of variance (F=0.019and P=0.996) reveals that there is no statistically significant mean difference among adoption categories. Moreover, the bivariate correlation confirms the existence of negative and insignificant association between distance to market centre and adoption of onion production technology. This is because of the market centre to all sample households is found on average almost at equal distance shown in Table29. The result of this study is in line with the findings of Rahimeto (2007).

4.6.4.4 Participation in cooperative society

According to the information obtained from district office of agriculture, there are 32 agricultural development related co-operatives in the district (appendix table 14). Out of 32 cooperatives 17 are multi purpose cooperatives, 6 are irrigation development cooperatives, 6 are financial oriented cooperatives, 2 dairy developments and 1 is fishing cooperatives.

Currently multi purpose cooperatives undertaking milling service, supplying basic household goods, distribute agricultural inputs in collaboration with Agricultural Input Supply Corporation (AISCO), and Union cooperatives. These cooperatives also coordinate financial distribution obtained from commercial bank of Ethiopia in order to purchase agricultural inputs.

The financial co-operatives undertaking two types of services, which are distribution of credit money to members and collection of saving money from members. Each member can borrow money 3 times as much as his saving contribution.

With regard to irrigation cooperatives the main purpose is to provide farm input for members like, seed, farm implements, and perform management of irrigation water.

Cooperatives serve as an important source of rural credit and input supply. A farmer who is member of service cooperative has more chance to get credit. Therefore, the membership in cooperative was hypothesised to have positive and significant relationship with adoption of improved onion production package.

As was expected, the membership of cooperative society had significant relationship (χ^2=9.116, P=0.028) with the adoption and intensity of adoption of improved onion production package at 5% level of significance (Table 30). The majority (58.6%) of total sample households were found to be cooperative members and the rest 41.4% were reported to be non members. From non adopter group only 34.4 % respondents were the member of cooperative society.

The significant relationship between member of a cooperative society and adoption is an indication for the importance of rural financial institutions in supporting agricultural production particularly vegetable farming. Cooperative members were found to be better in access to and use of credit services.

Table 29: Relationship between participation of respondents in cooperative society and adoption of improved onion production package (%)

Farmers response	Adoption category				Total
	Non adopter	Low	Medium	High	
No	65.6	33.4	34.8	45.5	41.4
Yes	34.4	66.6	65.2	55.5	58.6
Total	100(29)	100(33)	100(69)	100(9)	100(140)

Source: survey result,2008, ( ) = N; (χ^2 = 9.116, df = 3, p = 0.028; Crammer's v = 0.225)

4.6.4.5 Attending extension events

In this study, participation in training, demonstration and field day were considered as the most important extension events. The sample households' participation in different extension events in relation to onion production is discussed in the following pages.

Training

Training is an important input to improve farmers' performance. It equips farmers with new knowledge and skills, which help them to perform new practice properly. If a farmer has no skill and technical know-how about certain technology, he/she may have less probability of its adoption. The skill acquired through training helps to carry out a new technology effectively and efficiently. If farmers are well trained in new practice, they may not need outside support later. They can properly implement technology package as per the recommendation. Concerning farmers' attending training programs, out of total 140 farmers interviewed 53.6% of them had attended training while 46.4 % did not attend training program related to improved onion production (Table 31).

Table 30: Extension training Programs attended by respondents (%)

Frequency of attending training	Adoption category				Total
	Non adopter	Low	Medium	High	
Never	68.9	39.4	42.0	33.3	46.4
Sometimes	1.2	45.4	36.6	33.3	33.6
Most often	29.9	15.2	20.4	33.4	20.0
Total	100(29)	100(33)	100(69)	100(9)	100(140)

Source: Survey result, 2008, χ^2=29.674, df =12, p=0.003, Cv =0.275

With regard to the adoption category, 68.9% respondents never participated in training, only 31.1% of the non adopters attended training at different level of frequency. To determine the relationship between training and the adoption of onion production package chi-square test was computed. The chi-square analysis showed that (χ^2=29.674, p=0.003) there existed a significant relationship between them at 1% probability level (Table 31).

Field day

Field day is one of the most popular methods of transfer of technology .Conducting field days on farmers' field is a good way of convincing other farmers to adopt new technology. In field day neighbouring farmers will get an opportunity to observe how the new technology is put in to practice in the field. This situation may facilitate the adoption process. Table 33 clearly indicates that, from the total sample households 37.9% of farmers have attended field days at different level of frequency while majority of the farmers (62.1 %) did not attended in field day program.

The participation of respondents in field day with varying level of frequency of low, medium, and high adopters can be observed in Table 32. To determine the relationship between field days with the adoption of onion production package chi-square analysis was conducted. The chi-square analysis showed (χ^2=18.837, p=0.027) that there existed a significant relationship between them at 5 % probability level (Table 32).

Table 31: Field day programs attended by the respondents (%)

Frequency of Attending Field days	Adoption category					
	Non adopter	Low	Medium	High	Total	χ^2
Never	72.4	81.8	53.6	22.2	62.1	
Sometimes	24.1	3.0	14.5	22.2	14.2	
Once a week	3.5	12.2	23.3	33.4	17.1	
Most often	0.0	3.0	8.6	22.2	4.6	
Total	100(29)	100(33)	100(69)	100(9)	100(140)	18.837**

Source: survey result, 2008, (χ^2=18.837,df=9,p=0.027,Cramers v=0.275)

Demonstration

Demonstration means under taking field trial on farmers with aim of creating a learning site for the surrounding farm community. Demonstration is an important method of extension to create concrete awareness among the farm community. This situation may facilitate the adoption process. It is also a means of diffusing information to neighbouring farmers to see and then adopt the practice into their farm.

Table 32: Distribution of respondents by their participation in demonstration (%)

Frequency of attending	Adoption category					
	Non adopter	Low	Medium	High	Total	χ^2
Never	68.9	39.4	42.0	51.0	46.4	
Some times	31.1	42.4	36.6	49.0	33.0	
Most often	0	18.2	21.4	0	20.6	
Total	100 (29)	100 (33)	100 (69)	100 (9)	100 (140)	13.133**

Source: survey result, 2008, ** = significant at 5% probability.

Table 33 indicates that only 53.6 % of total sampled households have participated in field trial demonstration on improved onion production package and the rest 46.4% did not participated. Chi-square test indicated that, there is a significant (χ^2 =13.133, P=0.015) relationship

between non adopters and adopter categories at 5% probability level. Though participation in demonstration significantly and positively influence the adoption of onion technologies.

Demonstration in this study means accepting new practices and put in to practice in the field in the form of trial with close supervision of extension agents and then inviting others to visiting how she/he perform it. In these findings, farmers who participated in demonstration were all of adopter categories. The probable reason for this deference is that extension agents may select the one who accept the technology easily to put in to practice according to the recommendation.

When farmers have a chance to participate in practicing on-farm trial they may develop know-how more about the fitness of the packages with their socio-economic conditions, this enhances them to take further measures, either to use or not the technological packages. Similar results were identified by Legesse (1992), Edlu (2006**) .**

4.6.5 Psychological factors

The relationship between adoption category with the variables of farmers' perception, cosmopolitness and leadership status are discussed here below.

4.6.5.1 Farmers' perception

Farmers' perception on use of technology is generally attached with the advantage of technology components. Farmers examine the advantages from the point view of compatibility to their current situation, with labour demand, profitability, and other social necessities to adopt a technology. If farmers perception is positive towards the advantage of technology it will enhances decision in favour of adoption of the technology.

According to Duvel (1975) Perception is a key dimension in behavioural change process. Perception about the relative advantage of different package practices was assumed to have positive effect on adoption of improved onion production package. The more accurately a farmer perceives his current poor production efficiency, the more likely he is to alter his

behaviour and thereby improve his production efficiency. For example, the need for technical assistance, early maturity, and yields advantage, income and employment generation is assumed to be incentives for adopting onion production. On the other hand incompatibility like availability of seed, initial cost for water pump, and market problem are negative attributes related to improved onion production package. The sample households' response on perception of implementing onion production package and its use is presented in Table 35.

In the present investigation, the respondents were asked to give their response regarding how they perceive advantages of improved onion production package over the traditional way of cultivating the onion crop. Total perception score for relative advantages of the recommended package practices for whole respondents was 3302. This number was divided by 140 to get the average total score for a household head in the sample and it was found to be 23.5. Finally this number was again divided by the total practices (7) of the technology listed to be rated by an interviewee. The resulting figure was 3.3, which is a bit larger than the median score (3), implying slightly positive perception towards technology package practices. This figure masks the very negative perception farmers have towards improved onion variety; hence care should be taken so as not to forget or misguided by this figure, which is the result of high influence of package practices advantage ratings of the respondents.

Table 34.Total perception score on advantages of recommended practices of the package

Adoption categories	N	Mean	SD	F	P
Non Adopter	29	24.4	2.1		
low	33	21.2	1.5		
Medium	69	25.3	2.5		
High	9	23.4	2.3		
Total	140	23.5	2.1	-5.34	0.000***

Source: survey data, 2008. ***= significance at 1% significance level

As can be seen from Table 34, the mean perception scores on advantages of technology attributes for non-adopters, low, medium and high adopters' categories were 96.5, 72.7, 78.3 and 98.4 respectively. One way analysis of variance was conducted to see whether difference exists between adoption categories in terms of the perception on relative disadvantage of haricot bean technology package. Accordingly, the ANOVA result shows the existence of significant difference (F=5.34, p=0.00) between adoption categories at 1 percent probability level. Multiple comparison post hoc test result was also computed to see where the variability lies and it was found that significant mean difference was observed between categories of non adopters with high adopters at 1% probability level. This indicates that adopters have low score on relative disadvantage which means that they did not perceive the package as highly disadvantageous compared to non adopters, who perceived it as disadvantageous. Similarly, the result of correlation analysis shows that the relationship between adoption of haricot bean technologies and perceived relative disadvantage was found to be negative and significant. The results are in agreement to, Ibrahim. (2006) and Rahimeto (2007) who reported similar result in their study on adoption of improved technology.

4.6.5.2 Cosmo politeness

Cosmo politeness- is the degree of orientation of the respondents towards outside the social system to which he belongs. It can be measured by frequencies of visits to outside her/his area of residence for several reasons. Cosmopolite ness as independent variable is expected to have positive relationship with the adoption of an innovation, Rogers and Shoe makers (1971). It provides more chance of exposure to external information and environment.

Table 33: Distribution of respondents on the basis of their visit to near by town (%)

Frequency of visit near by town	Adoption category				Total	χ^2
	Non adopter	Low	Medium	High		
Never	13.9	24.2	0	0	8.5	
Sometimes	44.8	6.0	47.8	44.4	37	
Once a week	41.3	69.8	44.9	44.4	50	
Most often	0	0	10.3	0	3.5	
Daily	0	0	0	11.2	1.0	
Total	100(29)	100(33)	100(69)	100(9)	100(140)	51.460***

Source: survey result,2008,(χ^2=51.460, df, =12, p=0.000, CV=0.350), *** = Significance at 1% significance level

It can be seen from Table 35 that 8.5 % of the respondents never visited the near by town while the rest 37%, 50%, 3.5%, and 1% of total sample households visited the nearby town sometimes, once a week, most often and daily respectively.

The main purpose of visiting the nearby as expressed by them was to purchase farm inputs and to sale farm produces. Some of them were visiting the near by town to visiting relatives and friends, for medical treatment, and for entertainment purpose. The crostab analysis (χ^2=51.460, p=0.000) revealed that there existed a significant relationship between cosmopolitness and adoption of improved onion production package.

4.6.5.3 Leadership status

Usually participation in the community development activities is perceived as a willingness of a person to work together. The relationship between leadership and adoption is associated with interpersonal networking and exchanges between adopters and non adopters of technology.

In this study leadership is hypothesised as involvement of the respondents in any informal and formal organizations as a member and leader position. Farmers who have some position in any local organizations are more likely to be aware of new information and practices. Therefore, it was expected that there would be positive and significant relationship between leadership and the adoption of onion production package.

Table 34: The relationship between leadership status of respondents and adoption of improved onion production package (%)

Participation in leadership	Adoption category				Total
	Non adopter	Low	Medium	High	
No	58.6	9.0	27.5	33.3	30
Yes	41.4	99.1	72.5	66.7	70
Total	100(29)	100(33)	100(69)	100(9)	100(140)

Source: own survey (2008), ( ) = N, (χ2=18.429, p=0.000, CV=0.363, df =3), significant at 1%

As indicated in Table 36, from the total sample households 70% participated in different leadership status and the rest 30% did not participate as leadership. From the adopter group's none, medium, and high adopters participated with 41.1%, 99.1%, 72.5%, and 66.7% respectively. From the total respondents 98 of them were participating at different level of leadership status at different local organizations (appendix table 15). Chi- square (χ^2=18.429, p=0.000) statistical analysis revealed that there is significant relationship between adoption and leadership on influence of adoption of onion production package. This study is in line with the findings of Tesfaye (2006) where he detected a positive relationship between leadership status and adoption of rain water harvesting technology.

4.7 Summary of Results of Descriptive Statistics

A total of 18 (5 continuous and 13 dummy) explanatory variables were discussed in the above pages and out of these variables 9 of them revealed significant association with the adoption of improved onion production package. Summary of the overall descriptive results is depicted in tables below.

Table 35: Summary statistics of Continuous Independent Variables

Variables	Mean across adoption categories				Expected sign	Observed sign	F value
	Non	Low	Medium	High			
LANDSZ	0.44	0.49	0.54	0.65	+	+	0.602 NS
LABOR	3.31	3.61	3.81	3.85	+	+	2.051 NS
AGE	42.93	43.88	44.86	41.44	-	+	1.305 NS
FAEXP	4.28	3.76	4.36	5.60	+	-	2.015 NS
MARKT	12.55	12.48	12.42	12.0	+	+	0.996NS
LIVOWN	5.7	8.12	7.86	6.88	+	+	1.396 NS
PERCEP	24.4	21.2	25.3	23.4	+	_	5.43***

Source: survey result, 2008, NS=Non Significant

Table 36: Summary statistics of Dummy/ discrete Independent Variables

Variables	Percentage proportion across adoption categories				Expected sign	Obser-ved sign	χ^2 value
	Non	Low	Medium	High			
EDUHH					+	+	12.097***
-literate	82.7	69.6	60.8	22.3			
-illiterate	17.3	30.4	39.2	77.7			
SEX					+	-	12.708***
-Male	86.0	76.0	97.0	100			
-Female	14.0	24.0	3.0	0.0			
OFFEMP					+	+	2.888
-Yes	0.0	9.1	8.7	11.7			
-No	100.0	90.9	91.3	88.9			
LEADER					+	+	18.429
-Yes	41.4	99.1	72.5	66.7			
-No	58.6	9.0	27.5	33.3			
CREDIT					+	+	12.674***
-Yes	13.8	55.5	57.9	33.3			
-No	86.2	45.5	52.1	66.7			
EXTCON					+	+	7.691***
-No contact	51	24.2	7.2	0.0			
-Once in a week	0.0	3.0	8.7	22.0			
-Fortnightly	0.0	6.0	31.9	33.6			
-Only planting period	18.1	21.3	27.6	44.4			
-During input provision	10.3	30.3	15.9	0.0			
-During credit collection	20.6	15.2	8.7	0.0			
MEDIA					+	+	2.618
-Yes	62.1	66.7	76.8	66.7			
-No	37.9	33.3	23.2	33.3			
COOPS					+	+	9.116***
-Yes	34.4	66.7	76.8	66.7			
-No	65.6	33.4	34.8	45.5			
TRAIN					+	+	29.674***
-Never	68.9	39.4	42.0	33.3			
-Sometimes	10.2	45.4	36.6	33.3			

Variables	Percentage proportion across adoption categories				Expected sign	Obser-ved sign	χ^2 value
	Non	Low	Medium	High			
-Most often	30.9	15.2	20.4	33.4			
FIELDAY					+	+	18.837**
-Never	72.4	81.8	53.6	22.2			
-Sometimes	24.1	3.0	14.5	22.2			
-Once a week	3.5	12.2	23.3	33.4			
-Most often	0.0	3.0	8.6	22.2			
COSMO					+	+	51.460***
-Never	13.9	24.2	0.0	0.0			
- Sometimes	44.8	6.0	47.8	44.4			
-Once a week	41.3	69.8	44.9	44.4			
-Most often	0.0	0.0	10.3	0.0			
- Daily	0.0	0.0	0.0	11.2			

Source: survey result,2008, **, *** = Significant at5 %, 1% probability level.

4.8 Results of the Econometric Model

The purpose of this section is to identify the hypothesized independent variables that influence the dependent variable using Tobit model. Before running the model analyses the existence of a serious of multicollinearity or high degree of association problem among independent variables for all continuous and discrete variable were checked by Variance Inflation Factor (VIF) for continuous explanatory variables and contingency coefficients for dummy explanatory variables..

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4.8.1 Determinants of probability and intensity of adoption of improved onion production package.

A total of 13 explanatory variables were considered to be included into the Tobit econometric model (Table 39). Out of which seven variables were found to significantly influence probability of adoption and intensity of adoption of improved onion production package. These include education of the household head, access to credit service, membership of

cooperatives, orientation towards out side social system (cosmopoliteness), participation in field day, participation in training, labour availability and farmers' perception towards the components of improved onion production package.

Educational level of household head (EDUHH): Education had a positive and significant relationship with the intensity of adoption of improved onion production package at 5% probability level. This explanatory variable accounts 5.3 % of the variation in adoption and intensity of improved onion production**.** This shows that being literate would improve access to information, capable to interpret the information, easily understand and analyze the situation better than illiterate farmers. So, farmer who are literate were likely to allocate larger size of farmland proportion than those illiterate farmers. This result has supported by other previous studies such as the findings of Lelissa and Mulate (2002), Yitayal (2004).

Access to credit (CREDIT): As the model result indicates, the variable access to credit had positively and significantly influenced the likelihood of adoption of improved onion production package at less than 10% significance level. This explanatory variable accounts for 1.1 % of the variation in adoption and intensity of use of improved onion production package. From this result it can be stated that those farmers who have access to formal credit are more likely to adopt improved onion technology than those who have no access to formal credit. So strengthening and expansion of credit institution in to rural area is of paramount importance to address credit needs of farming community. The result of this study is in agreement with Legesse, (1992) and Rahimeto, (2007).

Membership of cooperative (COOP): Participation in cooperative society had positive influence on adoption and intensity of adoption of improved onion production package at 10 % level of significance. The variable accounted for 10% of the variation in probability and intensity of adoption of improved onion production. Organizing of farmers to be a member of cooperative society would facilitate access to credit, access to extension information and access to market. This implies strengthening and expansion of rural cooperatives is of paramount importance to enhance adoption of improved onion production package.

Frequency of visits out side social system (COSMO): is the degree of orientation of the respondents towards outside the social system to which he belongs. It provides more chance of exposure to external information. In this study cosmopolitness has positive and significance influence on the adoption and intensity of improved onion production package at 5% significant probability level. This explanatory variable accounts for 21.8% of the variation in probability and intensity of adoption of improved onion package. This implies that a farmer who more frequently visits out side of his social system will have more information which helps him to adopt new technology. So the current extension service deliver organization should have to arrange visiting tour programs to the area where best practices are found. Then selected farmers who have a capacity to transfer skill and knowledge to others will participate in visiting program.

Farmers' perception towards improved onion production package (PERCEP): Farmers' perception has negatively significant influence the probability and intensity of improved onion package at 1% level of probability. The variable accounts for 32.7% of the probability and intensity of adoption of improved onion production package. As mentioned in the descriptive statistics part, some practices of onion production package were difficult to implement by onion growers and this resulted in negative perception. So farmers put in to practice those components which were not difficult to implement. The result of this study is supported by Kebede (2006), and Paulos (2002).

Participation in extension training (TRAIN): Training is one of the extension events where by farmers get practical skill and technical information for new technology. Results of the study indicated that participation in training was positively and significantly related to adoption of improved onion production package at 1% significance level.

The variable accounted for 23.4 % of the variation in the adoption and intensity of adoption of improved onion production package. The implication is that emphasis has to be given to farmers' technology package through training to enhance adoption of improved onion production package.

Attending Field day (FIELDAY): It was found that exposure to information due to participation in field days had positive and significant influence on the probability of adoption of improved onion production technology at less than 5% significant level.

The result of Tobit model in relation to this variable shows that farmers who have an opportunity to attend field day of improved onion crop are more likely to use improved onion technology than those farmers who have no similar opportunity. In another word, the result indicates that farmers who are exposed to formal extension information have a higher probability towards adoption than those with less exposure. When farmers observe a new practice they can weigh the advantage and disadvantages of the new technology. his can facilitate adoption and helps them to implement the new technology properly. This variable accounts for 14.8% of the variation in probability and intensity of adoption of onion production package.

Table 39: Maximum Likelihood Estimates of Tobit Model

Variables	Estimated Coefficient	Standard error	t-ratio	P = Value
Constant	0.23241415	0.975985	1.878*	0.0604
CREDIT	0.01106956	0.00062994	1.698*	0.0895
COOP	0.10014249	0.00121414	1.527*	0.0708
COSMO	0.21830179	0.10304032	2.119**	0.0341
EXTCON	0.15784599	0.37466482	0.421	0.6735
EDUHH	0.05363050	0.04439249	1.975**	0.0483
FIELDAY	0.14897985	0.13850519	1.9044**	0.0465
LEADR	0.11495962	0.18392972	0.625	0.5320
LOBOR	0.01943201	0.01732998	0.432	0.3520
MEDIA	0.00666348	0.05921739	0.113	0.9104
OFFEMP	0.22685218	0.36510413	0.621	0.5344
PERCEP	-0.32736230	0.16205005	-5.723***	0.0000
SEX	-0.02082308	0.23014591	-0.090	0.9279
TRAIN	0.23458472	0.16066755	2.705***	0.0068
Sigma	0.83470793	0.05883744	14.187***	0.0000

Log likelihood function = 185.9330
ANOVA based fit measure = 0.417044
P = 0.000

Source: Model out put, ***, **,* represents 1%,5%, and 10% level of significance

4.8.2. Effects of changes in the significant explanatory variables on probability of and intensity of adoption of improved onion production package

All variables that were found to influence the adoption and intensity of use of onion production packages might not have similar contribution in influencing the decision of farm household. Hence, using Limdep computer software program Tobit model was run in order to assess the effects of changes in the explanatory variables into Probability of adoption and intensity of adoption. The results are presented in Table 37.

Table 37: Effects of changes in significant explanatory variables on adoption and intensity of adoption of improved onion production package

Variables	Change in probability of adoption	Change in intensity of adoption	Change among the whole
Constant	0.03058	0.04839	0.03526
EDUHH	0.02315	0.03663	0.02669
COOP	0.01541	0.02439	0.01777
COSMO	0.03787	0.05993	0.04367
PERCEP	-0.05074	-0.08029	-0.05850
TRAIN	0.20203	0.31969	0.23293
FIELDY	0.02247	0.03392	0.01285
CREDIT	0.01671	0.02644	0.01927

Source: Model out put.

The results computed indicate that the estimated increase in the probability of adoption and intensity of adoption of improved onion production package resulting from education status of the household is 2.3 % and 3.6 % respectively. The relatively better adoption of the literate farmers were due to the fact that literate farmers have better exposure to market oriented production and allocate more land for improved onion production than illiterate farmers.

The marginal effect result also shows that the estimated increase in the probability and intensity of use of improved onion production package resulting from participating cooperative association towards improved onion production package is 1.5 % and 2.4 % respectively. This implies that strengthening and promoting of cooperatives in farming community will enhance the adoption of new technology including onion package.

The marginal effect result shows that, an increase in frequency of visiting out side of a given society increases probability of adoption and intensity of use of improved onion production package by 3.7 % and 5.9 % respectively. This indicates that, arranging education visits for farmers should be encouraged as extension methods to promote technology adoption.

The results computed indicate that the estimated increase in the probability of adoption and intensity of use of improved onion production package resulting from having access to credit is 1.6 % and 2.6 % respectively.

The estimated influence of perception towards use of improved onion production technology attribute has negative influence and results in a reduction of probability of adoption and intensity of use of improved onion production package by 5.0 % and 8.0 % respectively. The negative sign indicates the presence of some components of the package which were not practiced by the onion growers.

An increase in attendance in extension training increases probability of adoption and intensity of use of improved onion production package by 20.2 % and 31.9 % respectively. This implies the need to give emphasis to strengthening institutional supports to improve farmers' access to extension services and their participation in extension to enhance adoption of improved onion production package.

The marginal effect result also shows that the estimated increase in the probability and intensity of use of improved onion production package resulting from attending in field day visit programs of improved onion production package is 2.2 % and 3.4 % respectively. Field day is also an important method of extension to pull farmers in accepting technology

packages. In field day visit program, farmers can have an opportunity to see, to touch, to ask questions and get answer about every thing during in field day program. Therefore the extension service has to take in to consideration the conduct of a variety of extension events as a major component of extension to promote technology adoption.

Based on this fact, in this study the unit increase in an explanatory variables there will be certain percent increase on the probability of adoption and intensity of use of improved onion production package. Therefore the current extension service has to given more emphasis to work on improving the influencing factors of onion production factors.

5. SUMMARY AND CONCLUSION

5.1. Summary

The study area, Fogera district, is one of the potential onion producing districts found in western part of the Amhara regional national state. The main theme of this study was to identify farmers' evaluation criteria and factors influencing the intensity of adoption of improved onion production package. A total of 140 sample households (126 male and 14 female) drawn from 8 *kebeles* of the district were interviewed using structured interview schedule. Qualitative data were collected using group discussion among selected onion growers and extension development agents who were working in the respective *kebeles* .

The analysis was done with the help of descriptive and econometric tools employing SPSS and LIMDEP software. Mainly Chi-square test and F-test were used to test the variation of the sample group they have towards adoption of onion production package. The econometrics model Tobit was employed to estimate the effects of hypothesized independent variables on dependent variable. The summary of the study results are discussed here under.

All recommendation practices of the onion production package are not practiced in the study area. Some of the missing practices are chemical application and spacing between plants and rows. Among the total sample households none of them were put into practice the spacing between plants and rows as per recommendation. The major reason for not keeping the spacing between plants and rows was implementing spacing as per recommendation in their field consumes more labor and time. Further there is a variation in the adoption of package components, some practices like irrigation and weeding frequency are practiced as per the recommendation whereas other like seed rate and fertilizer application are below the recommendation.

The variations in adoption of the package practices among the households were assessed from the point view of various factors which influence farmers' adoption behavior. These influencing factors are categorized as social and economic, personal and demographic,

institutional and psychological factors. Most of the variables assumed to influence the adoption behavior were significantly associated with the adoption and intensity of adoption of improved onion production package.

Among the personal and demographic factors educational status and sex of the household head were significantly related to the intensity of adoption of improved onion production package. From a total of 140 sample households 14 were female households. Among these women households 10 of them were categorized under the low level of adoption category the other four female respondents were non adopters. This implies that male farmers were given more attention for onion production as compared to female counter parts. Education status of the household head was also having positive relationship with the intensity of the adoption of the onion production package.

Moreover, among psychological factors, farmers perception towards the implementation of improved onion production package and cosmopolite household head were found to be significantly related with adoption and intensity of adoption

In the case of institutional variables attending extension training, field day, frequency of contact with extension agent, access to credit, and membership of cooperative society were also have positive and significant relationship with intensity of adoption of improved onion production package. This indicates that implementing the components of improved onion production package as per recommendation by onion growers is relatively complex as compared to other crops. Thus farmers need to get information an institutional support like cooperative society and rural credit institutions are paramount importance to boost the onion yield.

The farmers' selection and evaluation criteria of improved onion verities were also conducted through the group discussions. In this respect, early maturity, better yield, good bulb size, bulb color, vigor seedling production quality and better storage time were the most important characteristics selected by farmers. Based on this selection criteria onion growers in the study

area choose Bombay red variety among the three (Adama red, Red Creole and Bombay red) new varieties disseminated to the study area.

Then again, results of the econometric model pointed out the relative influence of different variables on probability and intensity of adoption of improved onion production package. Thus, access to credit, participation in cooperative society, perception towards implementing the components of improved onion package, attending extension training and field day programme, educational status of the household head , and frequency of visiting out side the social system (cosmopolitness) were found to have significant influence on probability and intensity of adoption of improved onion production package.

5.2 Conclusion and Policy Recommendations

1. Onion production in *Fogera* district has increased significantly for the past 5 years. It has momentous contribution in annual households' income. Farmers grow onion crop for the purpose of selling to get cash. However, onion production is seriously affected by price fluctuation every year. In the year 2007, during harvesting time the average farm gate price for one kilogram of onion bulb was about 1.5 birr. The middlemen were the major collectors of onion produce from each grower with very low price. Nevertheless, farmers are faced with poor market opportunities they are eager to increase their production if they were supported with credit and extension services. Hence, the institutional support available in the area such as cooperatives, credit institutions and government extension service providers should have to exert little effort to solve the market problem of onion production.

2. As compared to cereal crops onion production requires a little bit more skill to implement the package practices in their farm field. Therefore arranging sufficient number of training, field day, and demonstrations are paramount importance to equip growers with onion production management skill. That is why the explanatory variable, education was having a strong relationship with probability and intensity of adoption of onion production in this study. This fact shows that the current extension service delivered to onion growers

has to change the past trends and give special emphasis on skill training of onion production management as well as market extension aspects.

3. The finding of this study revealed that the main differences in adoption level of onion growers was also related to access to credit, frequency of visiting near by town and perception towards the new practices of improved onion production package. Because of this those sample households who did not access to credit, who have no chance to visit other society and who have negative perception on the practices of onion production package did not adopt or adopt some part of the package practices. So that provision of credit for all and arranging field day visit and tour program with certain period of time in production season will be very much important to farmers to adopt new technology.

4. Being the member of cooperatives was also positively and significantly related with adoption of onion production package. Member of the cooperatives has got credit, seed, and fertilizer supply from the cooperative shop. So strengthening and expansion of cooperatives is one means to enhance onion production in the area.

5. The major constraint of onion production in the study area was the absence of reliable seed supply. In 2007 production period majority of adopter sample households (89.2%) were purchased seed from individual seed growers. In line with this the sample households were complained to the seed quality they purchased. The sample households further commented that, the seed purchased from the individual producer is by far better than the seed they purchased from the open market in quality wise. The problem in local seed producers is that there is no consistent supply of seed to onion growers. Some times they produce much and the other time they produce little amount of seed. This fluctuation of seed production by individual seed producers resulted in low seed supply and fluctuation of seed price which hamper the advancement of onion production. Hence the local government extension and research system has to give a due attention to local seed growers in providing technical back up and in certifying the seed they produce to keep the quality of seed.

6. In general, this study found that vegetable production has contributed to significant amount of income to sample households and brought change in their life. Farmers participated in group discussion articulated that they were benefiting from adoption of improved onion production and improving their way of life. The single most important improvement mentioned was the ability to send children to school, followed by improvements in housing condition.

7. One of the major problems to the development of onion production is poor marketing system. From the result of this study, it was realized that producers were not in a position to obtain better income due to low selling price which is related to so many factors such as poor access to market, lack of market information and exploitation by middle men resulted in poor bargaining power of farmers. Therefore, much emphasis has to be given to improvement of marketing system particularly through cooperative unions. These cooperative unions should have to create reliable market price by communicate with other cooperatives found outside their localities.

8. The other problem observed in the study area is unplanned production of onion crop. Almost all farmers found in the study area plant the onion crop in the same planting date. The excess amount harvest reaches at the same time and this situation creates favourable condition for middle men to set low price on the onion harvest. So the extension service sector has to take in to consideration this issue, and training is needed for farmers to stagger the planting time. Staggering the planting time will have two advantages; one it reduces irrigation competition among growers in areas where there is water shortage, and the second one is there will be extended supply of onion bulb in the market and it keep up the market price.

9. Producers and extension agents need adequate skills in production management practices starting from seed selection to post harvest technology suitable at their level. Marketing principles, bargaining skills, business planning, quality management and post harvest handling of horticultural products are some of the interventions needed in study area.

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7. APENDICES

Table 1. Conversion factor used to compute man equivalent (Labour Force)

Age group (years)	Male	Female
< 10	0.0	0.0
10-13	0.2	0.2
14-16	0.5	0.4
17-50	1.0	0.8
> 50	0.7	0.5

Source: Stork, *et al.,* 1991.

Table 2 : Conversion factors used to estimate tropical livestock unit

Animal Category	TTLU	Animal Category	TTLU
Calf	0.25	Donkey (young)	0.35
Weaned Calf	0.34	Camel	1.25
Heifer	0.75	Sheep & Goats (adult)	0.13
Cow and Ox	1.00	Sheep & Goats (young)	0.06
Horse	1.10	Chicken	0.013
Donkey (adult)	0.70		

Source: Stork, *et al.,* 1991.

Table 3. Distribution of adopter sampled respondents average land covered with improved onion varieties

Land covered by improved onion variety over total onion land	Frequency	Percent	Cumulative Percent
0.125	15	13.5	13.5
0.25	26	23.4	36.9
0.50	31	27.9	64.8
0.75	17	15.3	80.1
1.00	12	10.8	90.9
1.50	10	9.1	100
Total	111	100	

Source: own survey result, 2008

Table 4. Distribution of adopter sample households based on their fertilizer use index

Fertilizer use adoption index, kg/ha	Frequency	Percent	Cumulative Percent
0.00	73	65.7	65.7
0.35	15	13.5	79.2
0.52	10	9.0	88.2
0.69	13	11.8	100
Total	111	100.0	

Source: own survey result, 2008

Table 5: Distribution of adopter sample households based on their weeding and cultivation frequency index

Frequency of cultivation	Frequency	Percent	Cumulative Percent
1.00	41	36.9	36.9
1.33	28	25.3	62.2
1.67	42	37.8	100.0
Total	111	100	

Source: own survey result, 2008

Table 6. Distribution of adopter sample households based on their irrigation practice frequency index

Irrigation frequency	Frequency	Percent	Cumulative Percent
1.0	28	25.3	25.3
1.5	52	46.8	72.1
2.0	31	27.9	100.0
Total	111	100	

Source: own survey result, 2008

Table 7. Distribution of adopter sample households based on their seed use index

Seed use index Kg/ha	Frequency	Percent	Cumulative Percent
0.50	13	11.7	11.7
0.80	9	8.2	19.9
1.00	71	63.9	83.8
1.50	15	13.5	97.3
2.00	3	2.7	100.0
Total	111	100	

Source: own survey result, 2008

Table 8. Distribution of Sample households in their age category

Age category	Adoption category				
	Non adopter	Low	Medium	High	Total
18-30	8	3	5	1	17
31-45	9	18	35	6	68
46-60	9	11	21	2	43
>60	3	1	8	0	12
Total	29	33	69	9	140

Source: own survey result, 2008

Table 9: Distribution of Sample households' in their family size

Family size in range	Adoption category				
	Non adopter	Low	Medium	High	Total
1-5	15	15	30	5	65
6-10	14	17	39	4	74
>10	0	1	0	0	1
Total	29	33	69	9	140

Source: own survey result, 2008

Table 10: Sample households *total farming* experience in years

Total farming experience in years	Adoption category				
	Non adopter	Low	Medium	High	Total
1-10	5	3	4	1	13
11-20	10	9	26	4	49
21-30	8	13	19	2	42
31-40	4	6	14	2	26
41-50	2	2	6	0	10
Total	29	33	69	9	140

Source: own survey result, 2008

Table 11: Distribution of Sample households' in *onion farming* experience* in years

Onion farming experience in years	Adoption category				
	Non adopter	Low	Medium	High	Total
1-5	21	29	51	5	106
6-10	8	4	18	3	33
11-15	0	0	0	1	1
Total	29	33	69	9	140

Source: own survey result, 2008, *=Onion farming includes both local and improved varieties

Table 12. Education level of the sample households

Education level	Adoption category				Total
	Non adopter	Low	Medium	High	
Illiterate	24	23	42	2	91
Less than six grade	5	7	21	6	39
7-12 grade	0	2	5	1	8
Certificate	0	1	1	0	2
Total	29	33	69	9	140

Source: own survey result, 2008

Table 13. Distribution of sample households in their total own land size

Total own land in hectare	Adoption category				Total
	Non adopter	Low	Medium	High	
0.25- 1.0	25	10	16	3	54
1.1-2.0	4	20	47	4	75
2.1-2.5	0	3	6	2	11
Total	29	33	69	9	140

Source: own survey result, 2008

Table 14. Types cooperatives in Fogera district

Type of cooperatives	Number of cooperatives	Cooperative members		
		Male	Female	Total
Multi purpose cooperatives	17	9864	1996	11860
Irrigation cooperatives	6	558	62	620
Credit and saving cooperatives	6	359	183	542
Dairy development cooperatives	2	91	7	98
Total	31	10872	2248	13120

Source: District agricultural rural development office, 2008

Table 15: Distribution of Respondents by their leadership status in different local organization

Type of organizations	Number of respondents with Leadership position		
	Chair person	Executive member	Total
Cooperative	10	17	27
Kebele administration	4	10	14
Women association	3	9	12
Religious organization	2	10	12
Edir/Mahiber	8	3	11
Water user association	2	4	6
HIV/Aids club	3	3	6
Parent committee of school	3	7	10
Total	35	63	98

Source: own survey result, 2008

Table 16: Recommended Practices of improved onion production packages

No	Type of Practices	Recommendation
1	Seed rate	3.5-4kg/hectare
2	Fertilizer application	200kg DAP &100kg urea/hectare
3	Chemical application(fungicide)	3.5 kg Ridomel or Mncozeb mixed with 600 litre/ha
4	Spacing	10x20x40 cm
5	No .of Cultivation & weeding	2-3 times in production season
6	Irrigation frequency	2 times per week for the first three weeks and 5-7 days then after

Source ; MoARD 2005

Table 17. Variance inflation factor for the continuous explanatory variables

Variable	Tolerance R^2	Variance Inflation Factor (VIF)
AGE	0.877	1.141
FARMEXP	0.935	1.070
IRLANDSZ	0.833	1.201
LIVOWN	0.883	1.194
LABOR	0.778	1.285
PERCEP	0.853	1.151

Source: own survey,2008

Table 18..contingency coefficients for discrete explanatory variables.

No	Variables	1	2	3	4	5	6	7	8	9	10	11
1	CREDIT	1										
2	COOPS	0.26	1									
3	COSMO	0.08	0.06	1								
4	EXTCON	0.18	0.10	0.29	1							
5	EDUHH	0.15	0.04	0.27	0.14	1						
6	FILDAY	0.12	0.24	0.21	0.21	0.27	1					
7	LEADER	0.23	0.34	0.06	0.05	0.09	0.16	1				
8	MEDIA	0.07	0.06	0.49	0.18	0.19	0.10	0.13	1			
9	OFFEMP	0.15	0.10	0.48	0.03	0.27	0.01	0.13	0.01	1		
10	SEX	0.16	0.06	0.28	0.09	0.15	0.10	0.02	0.29	0.09	1	
11	TRAIN	0.22	0.34	0.18	0.26	0.28	0.55	0.23	0.13	0.05	0.09	1

Source: survey result, 2008

Table 19: **The interview schedule**

Instruction

The following questions have been set to understand Farmers Evaluation criteria and Adoption of Improved Onion Production Package in Fogera District, South Gondar Zone, of Ethiopia. The answers are confidential and will not have any consequence on you personally in any ways. Please give correct answers to the following questions.

1. Identification:

1.1. Name of the Enumerator:_____
1.2. Education Level (fill grades completed, or certificate earned) _____
1.3. Affiliation of the Enumerator: _____
1.4. Date of the Interview: _____
1.5. Name of the respondent (he/she must be head of the Household)_____

1.6. Age of the respondent: [_____] years
1.7. Sex of the respondent 1. [ ] Male 2. [ ] Female
1.8. Education level of the respondent: 1. [ ] No formal education
2. [ ] 6th grade or less 3. [ ] 7th to 12th grade 4. [ ] Certificate
5. [ ] Diploma 6. [ ] Degree
1.9. Marital status (_) 1. [ ] Married 2. [ ] Unmarried 3. [ ] Divorce
4. [ ] Widowed

1.10. Woreda: _____
1.11 Kebele: _____
1.12. Distance to nearest town: [_____] km OR [_____] hrs walk
1.13. What is your major means of income generation?
1. [ ] Vegetable production 2. [ ] Fruit production
3. [ ] Cereal and pulses production 4. [ ] Cereal trading
5. [ ] Vegetable trading 6. [ ] Vegetable seed production
7. [ ] Livestock production 8. [ ] Livestock trading
9. [ ] Other income generation.

II. Household personal characteristics

2.1 Household demographic characterizes.

Sn	List of family members	Sex	Age	Education level	Family members working behaviour			
					Not working on farm	Permanently work on farm	Work on farm (but not permanently)	Reasons for not working
1								
2								
3								

2.2 Total Farming experience of the household head in years ----------Years.

2.3 Onion Farming experience of the household head in years----------

2.4 Main occupation of the household:
A. Farming only B. Farming and petty trading C. Farming and artisan D. Other

2.5 How far are you living from some service giving institutions in travel hours.

III. Household and Resource Data

3.1. Family size: [___] Male [___] Female [____] Total

3.2. Number of working persons: [___] Male [____] Female [____] Total

3.3. No. of children in school: [___] Male [____] Female [____] Total

3.4. Total crop land: _____ ha

3.5. Total irrigable area: ____ Timad_____ ha

3.7 What is the size of irrigable land used twice in a year? _____ ha.

3.8 What is the size of land covered by onion crop----------ha

3.8.1 By Improved variety ----------ha

3.8.2 By Local variety----------ha

IV. Crop production

4.1. Crop production during the last cropping season 1998/1999E.C

1	Crop type	Area Rain fed (ha)	Area Irrigated (ha)
1	Rice		
3			
4	Onion		
5	Tomato		

V. Household resources ownership

5.1 Land ownership (Own land) at present (1999 E.C)

Land allocation	Land size(ha.)
Crop Rain fed	
Crop Irrigated	
Grazing land	
Forest land	
Fallow and degraded land	
Homestead + others	
Total	

5.2 Additional land (if any) rented in/shared in/ contracted in last year (1999 E.C)

Land type	Tenure type			Total (in ha.)	Crop type produced
	Rented in	Shared in	Contracted in		
Rain fed					
Irrigated					
Grand Total					

5.3 Livestock ownership of the households

No	Type of Animals	unit	amount
1	Cows		
2	Oxen		
3	Heifers		

No	Type of Animals	unit	amount
4	Calves		
5	Bulls		
6	Goats		
7	Sheep		
8	Poultry		
9	Donkey		
10	Horse		
11	Others(specify)		
	Total		

5.4 House type and number of houses

No	House type	Number	Purpose
1	Grass roofed		
2	Corrugated iron sheet		

VI. Socio-economic characteristics of the household

6.1 Household labor availability and onion production activities they are engaged in.

No	Age category	Number(#)		*Activities engaged in	
		Male	Female	Male	Female
1	<10 years				
2	10-14 years				
3	15-50 years				
4	>50 years				

* Onion production activities includes: 1) Land preparation 2) Plantation 3) Weeding 4) Cultivation 5) Harvest 6) Transportation 7) Storage 8) Marketing 9) others (specify) –

6.2 Do you face labor shortage problem in onion production? 1) Yes 2) No

6.3 If yes, how do you solve labor shortage problem? 1) By hiring 2) asking for cooperation (Debo) 3) All 4) Others (Specify) ----------

6.4 Household's annual farm income from sale of crops in 1999 E.C

No	Commodity	Annual harvest(qt)	Consumed (qt)	Amount sold(qt)	Unit price	Total price
1	Rice					
2						
3	Onion					
4	Tomato					

Total income					

6.5 Annual income from sale of livestock in 1999 E.C

No	Animal type	Number sold	Unit price	Total price
1	Oxen			
2	Cows			
3	Heifers			
4	Bull			
5	Calves			
6	Goats			
7	Sheep			
8	Donkey			
9	Horse			
10	Poultry			
11	Honey			
	Total income			

6.6 Household's participation in off-farm activities in 1999 E.C

No	Who participate	*Type of activity	Duration(for how long)	Daily earning	Total income
1	Husband				
2	Wife				
3	Elder son				
4	Elder daughter				
	Total HH income				
* Type of activity 1) vegetable trading 2) Cattle trading 3) Grain trading 4) Hiring of donkey cart 5) Other (specify) ----------					

6.7 Household's participation in non-farm activities in 1999 E.C

No	Who participate	*Type of activity	Duration(for how long)	Daily earning	Total income
1	Husband				
2	Wife				
3	Elder son				
4	Elder daughter				
	Total HH income				
* Type of activity 1) daily laborer 2) handcraft 3) petty trade 4) remittance 5) Other (specify)					

6.8 Annual income from off-farm, activities (in birr)

s.no	Off-farm activities	Amount in Birr
1	Wage labour	
2	Others, specify	

6.9 For what purpose do you use the income from off-farm activities?
Purposes (in order of its share of income) 1) To purchase cloths for the family 2) To pay School fee 3) to purchase farm inputs 4) to settle debts 5) to buy food grains for the Family 6) others (specify) ----------

6.10 Are you member of cooperative society 1) Yes 2) No

6.11 If yes, when you first became member? Year: ----------

6.12 What services you are getting being member of the cooperative society
1) Credit in cash 2) Improved onion seed (Freely, on credit base) 3) Farm inputs (Fertilizer, chemicals, others) on credit base 4) Water pump service5) Market information
6) Marketing of onion harvest 7) other (specify) ----------

6.13 Do you have water pump by your own? 1) Yes 2) No

6.14 Do you rent your water pump to others? 1) Yes 2) No

6.15 If yes, how much do you rent (in birr) in a given period? ----------

VII) Information specific to Onion Production

7.1 Have you heard of improved onion variety? 1) Yes 2) No

7.2 If yes, when have you heard for the first time? Year heard: ----------

7.3 From whom you heard about improved onion variety?1) MoARD 2) Private investors
3) Individual producers producing onion in the area 4) NGO 5) Cooperative society
6) Neighbor farmers 7) others (specify) ----------

7.4 Have you ever grown improved onion variety(s)? 1) Yes 2) No

7.5 If yes, please provide the following information on onion varieties

No	Variety	Year of first grown	Being used/stopped	When stopped using the variety	*Reason for stopping
1	Adama red				
2	Bombey red				
3	Red Creole				
4	Others(Specify)				
* Reason for stopping 1) The coming of better variety 2) Unavailability of seeds 3) High purchase price of the seeds 4) others (Specify) ----					

7.6 If the answer to Q7.4 is No, which of the following are the reasons for not growing?

1) Shortage of capital 2) lack of water pump 3) High cost of production 4) Lack of experience 5) lack of extension advice 6) Other (specify)----------

7.7 Area Coverage by improved variety of onion in 1999 E.C

No	Name of the Variety	Area coverage(ha)
1	Adama red	
2	Bombey red	
3	Red Creole	
4	Others(Specify)	

7.8 Which improved onion variety you prefer and what are your preference criteria?

No	Variety name	Preference rank	*Reasons for preference
1	Bombey red		
2	Adama red		
3	Red creole		
4	Others(specify)		
*****Reasons for preference: 1) Better yield advantage 2) Good bulb size 3) Good bulb color 4) Earliness 5) Higher market demand 6) Better price 7) Better storability 8) Suitability for seed production 9) Good smell 10) others (Specify) ------			

7.9 In general, what criteria you consider to select among improved varieties of onion? (Give rank to the criteria)

No	Criteria	Rank
1	Better yield advantage	
2	Good bulb size	
3	Good bulb color	
4	Earliness	
5	Higher market demand	
6	Better price	
7	Better storage time	
8	Suitability for seed production	
9	Good smell(pungency)	

7.10 Who are your seed sources for the following improved varieties?

Name of the variety	Source(√)					
	Local Market	MoA	Research centers	Individual seed producers	NGO	Others (specify)
Adama red						
Bombey red						
Red creole						
Other(specify)						

VIII. Use of farm inputs for onion production

8.1 Which inputs other than improved varieties do you use for onion production and who are the sources?

Type of input	Specific name	Source(√)				
		Market	MoA	Research centers	NGO	Other source (Specify)
Fertilizer	DAP					
	Urea					
Chemicals	Fungicide					
	Insecticide					
Others(Specify)						

8.2 Do you use farm manure for onion production? 1) Yes 2) No

8.3 If yes, from where did you get it? 1) Collected from my own barn 2) collected from neighbor's freely 3) Purchased from neighbor farmers 4) Other source (specify)……..

8.4 Quantity of inputs purchased for onion production in 1999 E.C

No	Type of inputs	Specific name	Amount purchased/used (kg/Lit)	Unit price(Birr)	Total cost
1	seed of onion	Adama red			
		Bombey red			
		Red creole			
2	Fertilizer	Dap			
		Urea			
3	Chemicals	Insecticide			
		Fungicide			
		2. Nafita			
	Grand total				

8.5 In your view, how do you see the price of inputs used for onion production, please put tick mark?

Inputs	Price condition (√)				
	Very expensive	Expensive	Medium	Less expensive)	Not expensive
Improved seed					
Fertilizer					
Chemicals					
Fuel					
Labor					
Rent of water pump					
Others (Specify)					

8.6 Please, put tick mark the timely availability of the following inputs

Inputs	timely availability (√)				
	Not totally on time	Rarely on time	Some times on time	Mostly on time	Always on time
Improved seed of onion					
Fertilizer					
Chemicals					

8.7 Please, put tick mark on the quality of the following inputs

Inputs	Quality Rating (√)				
	Very poor	Poor	medium	Good	Very good
Improved seed of onion					
Chemicals					

8.8 Which of the following problems did you face with inputs provided by extension agents?

Inputs	Problems (tick √)				
	Low supply	Not timely	Poor quality	Expensive	Other problem(specify)
Improved seed of onion					
Fertilizer					
Chemicals					
Others(Specify)					

8.9 Which of the following problems did you face with inputs purchased from market?

Inputs	Problems (√)				
	Low supply	Not available on time	Quality is poor	Expensive	Other problem(specify)
Improved seed of onion					
Fertilizer					
Chemicals					
Others(Specify)					

8.10 Have you obtained credit for onion production in the last five years? 1) Yes 2) No

8.11 If yes, Please fill the following table

No	Credit source	Amount	*Purpose of use
1	ACSI		
2	Cooperatives		
3	BoARD		
4			
* Purpose: 1) For purchasing fertilizer 2) For purchasing improved seeds 3) For purchasing chemicals 4) For other purpose (Specify) ---------			

IX. Market related variables

Which market centres are accessible to you?

No	Name of the market	Distance(in km)	Commodities sold at the market place
1	Bahir dar		
2	Gondar		
3	Debretabor		

9.2 Where do you sell your onion harvest and to whom you sell

No	Place of sale	*To whom you sale
1	At farm gate	
2	At market	
*To whom 1) to whole seller 2) to retailer 3) to direct consumers		

9.3 How was the selling price of onion last year (1999 E.C)? ----------birr/kg or qt

9.4 In your view, how do you see the selling price of onion?

How do you see the selling price?	Price condition(√)				
	Very Poor(1)	Poor(2)	Medium(3)	Good(4)	Very good(5)

9.5 Do you get information on onion selling price 1) Yes 2) No
9.6 If yes, specify your source of information and indicate how often you get access to it.

No	Sources of information	How often you get access to it?				Rank
		Rarely (1)	Some times(2)	Often(3)	Very often(4)	
1	DA					
2	Traders					
3	Neighbour farmers					
4	Cooperative society					
5	Middle men					

9.7 What do you think are the major marketing problems with regard to vegetable marketing particularly onion? (Rank them in order of importance)

1) Low selling price 2) High input purchase price 3) Exploitation by middle- men4) Other

9.10 Is there price risk in production of onion? 1) Yes 2) No
9.11 If yes, indicate your degree of fear of risk on the following five-point scale

Price risk (√)	Very low	Low	Medium	High	Very high

X. Extension services

10.1 Do you get advisory services from extension agents on onion production? 1) Yes 2) No

10.2 If yes, how frequent the extension agents visit you during the production season?
1) Once in a week 2) Fortnightly 3) Monthly 4) Only during plantation 5) during input provision 6) during credit collection 7) others (Specify) ----------

10.3 Do you visit extension agent your self? 1) Yes 2) No

10.4 If yes, when do you visit? 1) During plantation for technical advice 2) During input provision to obtain inputs 3) It depends (any time when there is technical problem)

10.5 Who are your other sources of information on onion production and how often do you use/ have contact with them?

No	Other sources	How often you contact/use them					Rank
		Never	Rarely	Occasionally	Often	Very often	
1	Field days						
2	Training						
3	Fellow farmers						
4	Development agent						
5	Demonstration						
6	Cooperatives						
7	NGOs						

10.6 Please, indicate your participation in the following extension events related to Vegetable/onion production in the last 5 years

No	Extension events	Participated/not participated	Number of times participated in the last 5 years	*Who arranged for you?
1	Field day			
2	Training			
3	Demonstration			
Who arranged for you? 1) MoA 2) Research 3) NGO 4) Others (Specify *)----------				

10.7 Indicate your access to and frequency of use of the following media materials on agricultural programs related to vegetable/onion production

Mass media	Do you have?		How often you use them for attending agricultural programs/obtaining messages				
	1=Yes	2=No	Never(1)	Rarely(2)	Occasionally(3)	Often(4)	Very often(5)
Radio							
Television							
Leaf lets							
Pamphlets							
Manuals							

10.8. If you have a radio /TV which program do you watch mostly? (Rank according to their importance)

Agricultural program ( )
News ( )
Drama ( )
Music ( )
Others (specify) ( )

10.9 How frequently do you visit the nearby town or city? *(Cosmo politeness)*

1. Daily (4)
2. Most often (3)
3. Once a week (2)
4. Sometimes (1)
5. Never (0)

10.10 What is the purpose of the visit?

1. Agricultural related like purchase/shopping/marketing (4)
2. To visit friends/relatives (3)
3. To get medical treatment (2)
4. Entertainment (1)

1. Any other purpose (specify) _____

XI. Perception related variables

11.1 Interviewer's rating of the respondent's actual level of package adoption as compared to the optimum

Recommended practices	Interviewers rating comparing to the optimum(√)				
	Very low(1)	Low(2)	Medium (3)	high(4)	Very high(5)
Seeding rate					
Fertilizer rate					
Chemical application rate					
Frequency of cultivation					
Spacing					
Frequency of irrigation					
Total score					

11.2 What kind of view do you have on the advantages of the recommended rates of onion production package components described above as a whole?

a) Advantage is greater than the disadvantage

b) Disadvantage is greater than the advantage

11.3 If your perception is towards to more dis advantageous than advantageous to recommended Practices give your reasons?

XII. Adoption of Onion production package components

12.1 What is your level of adoption of the following Onion production package practices by 1999 E.C?

No	Package practices	Rate of application(Farmer's practice) per ha	* Reasons for not implementing according to the recommendation
1	Seeding rate		
2	Fertilizer rate ➢ DAP		
	➢ UREA		
3	Chemicals ➢ Fungicide		
	Insecticide		
4	Frequency of cultivation and weeding		
5	Spacing		
6	Frequency of irrigation		
* Reasons 1) I don not know the recommended rate 2) The recommended rate does not fit with my financial capacity 3) The recommended rate is not superior than our own practice 4) It is labor intensive 5) It does not fit with physical environment (soil, RF pattern) 6) It consumes more time and requires skill 7) Others (specify)			

XIII . Leadership

13.1. Are you involved in any activities of formal and informal institutions/ Organizations? in your area? (*Social participation***)** 1= Yes 0= No

13.2 If yes in which social organization you participate? a) Farmers cooperatives/union b) Peasant association c) Women's association d) Religious organizations (Mosque/ church)

e) Informal associations (Idir, Ekub. Mahber)

XIV. Major problems in vegetable production in general and onion production in Particular?

14.1. Generally, what are the major problems in vegetable production in general and onion production in particular? (Rank them in order of importance)

SN	Problems	Rank
1	High production cost	
2	Low selling price of onion	
3	Exploitation by middle men due to lack of market information and poor bargaining power	
4	Shortage of seed	
5	Lack of credit	
6	Lack of water pump	
7	Lack of enough extension support	
8	Lack of enough knowledge and experience on onion production	